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Tanks, gas, bombing, liquid fire

S. A. Dion

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TANKS, GAS, BOMBING, LIQUID FIRE

By

CAPTAIN S. A. DION
CANADIAN EXPEDITIONARY FORCE

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FOREWORD

The writer submits this book to readers in the hope that it will serve as a great aid in the instruction of the men for overseas service. All subjects treated are done so in the simplest manner possible and within the understanding of all.

This book is based on the practical experience of the writer while on service with his battalion in France and from his knowledge as an instructor on Bombing and Trench Warfare.

S. A. DION (CAPT.)

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BOMBING

To impress on all troops the real necessity for properly training all officers and men in this work and to make them realize how important it is regarded, the following extract from an order signed by the Chief of the General Staff of the German Field Army, "Von Hindenburg" and issued to the German officers shortly after the Somme engagements, is given below and reads as follows:

TRANSLATION OF AN ORDER ISSUED BY THE CHIEF OF THE GENERAL STAFF OF THE FIELD ARMY.

General Headquarters.

Chief of the General Staff of the First Army,

Ia No. 36017

1. The fighting at Verdun and on the Somme has very clearly emphasized the great importance attaching to the junior commands, from that of company commander downwards. It is particularly during severe fighting that leadership is most required by our men. The shortage, due to our heavy casualties, of experienced, energetic and well-trained junior commanders is sorely felt at the present time. The inevitable difficulties resulting from this state of affairs can only be met by the further development of training courses and drill of every kind, and by the constant further training of all ranks. For this purpose full advantage must be taken of every opportunity that arises when units are in the line, and more especially when they are resting.

Active service conditions have shown that it is incumbent on battalion commanders to continue the training of their officers, for which they are most favourably situated and which affords them a wide field of most practical and remunerative activity. Similarly, company commanders must persevere with the further training of their platoon, section or gun commanders. Enough cannot be done in this respect, even when the fullest use is made of the time available.

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I request all responsible officers to give their most earnest attention to this important and decisive question and to use every means at their disposal to keep the junior commanders of the present day up to the standard required for the proper performance of their arduous duties.

2. *From the reports received of the operations on the Somme front, I observe that due importance is not attached in all quarters to the training of the troops in bombing.*

In the training of infantry, far greater stress must be laid on the employment of hand grenades in attack and defence than has hitherto been the case. There can be no question of the separate training of specialists; all men of the infantry and artillery must be practised in the use of hand grenades, and be familiar with the principles of hand-grenade fighting. I request that, in so far as this has not been done, Armies will take immediate steps to improve training in hand-grenade fighting.

I recommend that troops be directed to lay out training grounds for themselves close to their billets.

I shall recommend the Minister of War to issue a badge to be worn by the best bombers, and some special mark of distinction for those men who in actual fighting have proved themselves to be exceptionally good bombers.

3. The rest period must, without fail, be devoted to the moral recuperation of the troops and to intensive training.

Undue leniency towards troops who may soon be faced by difficult tasks certainly does them more harm than a hardening process, thoroughly carried out with all means available, and making the utmost use of the time at one's disposal.

Apart from purely military training, I would lay stress on the great importance of games and practice in crossing obstacles. In the neighbourhood of any billet, suitable ground for both these purposes can be easily found or prepared.

In this connection also, I would request that pressure be constantly brought to bear on the men and an effort made to stimulate their interest.

(*Signed*) VON HINDENBURG.

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BOMBS AND GRENADES

Bombing and Grenade fighting in the present war has developed to such an extent, that the hand and rifle grenade has become an absolute necessity, as a means of defence and offense, and the greatest attention must be paid to training and developing this phase of Trench Warfare.

The requirements now in force provide that every man, officer and private, must have a knowledge of the common types of bombs in use, how to prepare and throw them, and in addition, should have a fair knowledge of how to de-detonate common types of German bombs, but the usual practice is not to touch these till examined by one of the more skilled grenadiers.

The practice in France has differed among the different units. One practice is for a battalion to have one whole platoon (approximately 60 men) who are specially trained in bombing work, this platoon acting really as a separate unit with its own bombing officer and subordinate commanders.

Other battalions have in every platoon a bombing squad of eight or nine men, an N. C. O. being in charge. These squads are given a special training of a higher grade than the others. They act with their platoons, but may be called out for special duty.

Naturally, the continual handling of bombs and grenades requires continual care and judgment, so that in the

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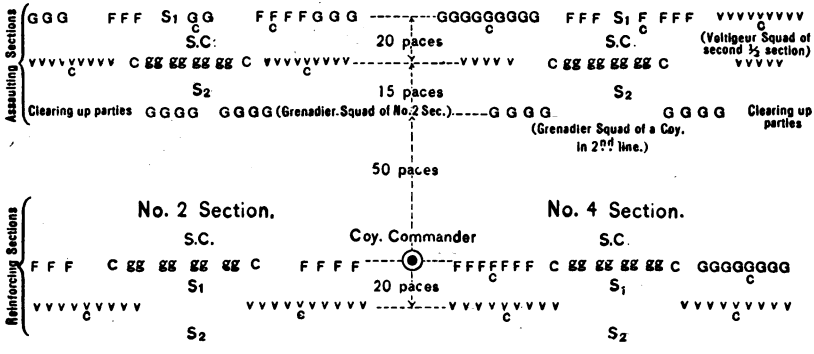
Adopted from the French Method

1ST LINE COY IN ATTACK FORMATION WITH 3 ASSAULTING SECTIONS

FRONTAGE 220 YARDS.



EXPLANATIONS.

G Grenadier.	Fc Fusilier Corpl.	gg. Rifle Grenade man.	S.C. Section Commander.
Gc " Corpl.	V Voltigeur.	C. Carrier	S_1 Sergt. of 1st ½ section
F Fusilier.	Vc " Corpl.		S_2 " " 2nd ½ section

◉ Company Commander

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Two throwers:

These men are picked for coolness and accuracy in throwing and are as lightly equipped as possible, as they require both hands to manipulate the grenade throwing. Their duty is to throw the grenades forward into the bays occupied by the enemy and force them out, and are directed by the leader.

One N. C. O. leader:

This man is in charge of the squad, and controls (by means of a periscope and otherwise) the throwing and direction of the bombs, preventing waste and indiscriminate throwing. He will signal his progress by flare lights at night and flag by day.

He must thoroughly inspect all men of his squad as to their equipment, supply of grenades, etc., and must make them acquainted with his successor should he become a casualty.

Two carriers (reserve throwers):

These men carry supplies of grenades and must always have one in readiness for their respective throwers. They must not obstruct the throwers by coming too close, and should their thrower become a casualty they are immediately to take his place.

One rifle bomber.

One spare man (reserve).

Their duty is to outrange hostile bombers with their rifle grenades and cover by fire the advance of the squad when a check is encountered, and also provide protection for the flanks. The reserve man may also act as a sniper to keep the heads of the enemy down and keep them from observing.

The figure on page 6 shows the method which the squad will adjust when working down or clearing a trench.

(See sketch "A"), page 6.

As can be seen, the squad on reaching traverse No. 2 bayonet men place themselves in positions (B. 1, B. 2). The first thrower follows (T. 1) behind the traverse with carrier (C. 1) immediately behind him. The N. C. O.

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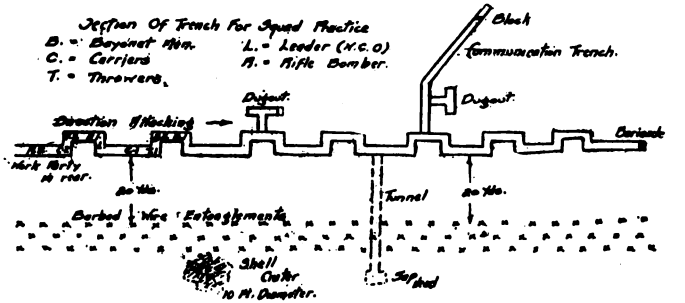

SKETCH "A."

(L. 1) in such position where he can observe and control the fire of the squad. The first rifle grenade men should be next to the leader, so that he comes immediately under his control.

The next thrower (T. 2) and carrier (C. 2) will follow next in the same order as the first two. They in turn are backed up by the second rifle bomber.

Preliminary Training.—The great object in the preliminary training is to give the man a good foundation for the work and give him confidence in his own powers.

The following points should be the great consideration:

A. He must be given a practical knowledge of the working of each grenade in use.

B. He must be taught to throw properly (individual throwing ideas should be discouraged).

C. He must have a fair idea of the general work of bombers in groups and otherwise in the attack and defense.

A suggested course of training is shown on page 7, which has been proved successful. Great attention must be paid in the first instruction of the men in throwing and the correct method insisted upon. Many will insist that grenades can be thrown baseball fashion. This idea should at once be disabused.

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SUGGESTIONS FOR SYLLABUS OF TRAINING.

A.—Elementary Training.

The following subjects should be included in the course:

Lectures.—(a) Handling grenades, and precautions necessary.

(b) Description of grenades in use and detailed description of Mills grenade.

(c) Care and storage of grenades.

(d) Organization and tactics of bombers in attack and defense.

Practical.—(a) Throwing dummy grenades in open and in trenches.

(b) Group practice, one man throwing, one preparing grenade, one keeping up supply of grenades.

(c) Practice in squads of eight working up trench with dummy grenades.

(d) Thowing live grenades, individual practice.

(e) If possible, practice in squads of eight with live grenades.

Following is a suggested syllabus for three days' elementary course:

First Day.—Opening lecture on detonators, fuses, igniters and grenades and their properties.

Demonstration of action in throwing grenades in various positions in the open by instructor, followed by practice by class.

Detailed description of Mills grenade and precautions to be taken with it.

Practice in throwing dummy grenades at 25 yards.

(i) Into a trench or pit.

(ii) Out of a trench.

(iii) Over a traverse.

Short drill to explain duties of various men in a grenade party.

Second Day.—Questions on previous day's work and drill.

Practice in throwing with dummies individually and in groups, in the open and from trenches.

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Lecture on care of grenades.
Lecture on organization and tactics of bombers.
Demonstration by trained bombing squad of method of working down a trench.

Third Day.—Questions on previous day's work.
Lecture on organization and tactics of bombers.
Individual throwing of live grenades.
Practice in squads of eight working down trench with dummy grenades.
Demonstration of method of blocking a trench.
Squads of eight working down trench with live grenades.

B.—Advanced Course.

The following subjects should be included:

Lectures.—(a) Details of grenades of various types, including the German.
(b) Details of rifle grenades, catapults and throwers.
(c) Organization and tactics of bombers in attack and defense, organization for raids or large attack. Co-operation of machine guns, tactical use of rifle grenades, catapults and throwers.
(d) Supply of grenades in an attack.

Practical.—(a) Improvement of accuracy and length of throwing hand grenades.
(b) Use of rifle grenades, rifle grenade stands, catapults and throwers.
(c) Various practices in attack and defense.
(d) Practice in rapid and continuous throwing.
(e) Thowing at night with live grenades.
(f) Methods of "blocking" a trench.

Great stress must be laid on throwing discipline. One well placed grenade is worth any amount of grenades thrown indiscriminately.

Men should first of all be practiced in throwing at measured distances in the open with dummies.

A good way of doing this is to mark out on the ground a series of double lines, each double line being 3 feet wide, to represent the width of a trench. The base line, also to represent the width of a trench on which the throwers stand, should be 20 yards from the first double line—then

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come three more rows behind the first one at distances of 25 yards, 30 yards and 40 yards.

Having once mastered the first distance, they should then throw at the further distances in turn.

The squads can be divided into two groups of four men, one group returning the dummies to the group throwing from the base line—by this means no time will be lost and every man will be kept interested in the proceedings.

A good method of practicing "indirect" throwing when the target cannot be seen is to fix up a canvas screen 9 feet in length and at least 8 feet in height.

The thrower stands behind the screen with an observer looking round the side of the screen, or using a periscope, who directs his aim by calling out after each dummy grenade is thrown, such as "Two yards more right"—"Eight yards farther," etc.

After the squads have obtained a good degree of accuracy, they should then throw into a trench, and be taught the correct method of working town a trench by throwing over the traverses.

If there is no trench suitable for practice, one must be made. If time and labor are not available for the construction of a long trench, a good plan is to dig two short trenches 20 yards apart, each consisting of two bays and two big traverses. This will give the men an opportunity of throwing from one trench into the other.

Suggestions for the Training of the Men.—The following suggestions could be followed for all men in the battalion during the training period:

Lecture on the handling of grenades and precautions to be taken.

Lecture describing grenades in use with particular attention paid to the Mills grenade.

Lecture on the care and storage of grenades.

Practical:

A. Handling and examination of grenades.
B. Throwing dummy grenades in all positions.
C. Practice in squads of eight along a dummy trench.
D. Throwing live grenades individually and in squads.
E. Practice throwing with equipment on.

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F. Night practice from trenches under active service conditions.

The following should be taken up with the advanced course:

Lecture on all grenades of various types and German grenades commonly used.

Lectures on bombers in the attack, raids, general attacks, etc.

Lecture on organization of bombers.

Lecture on supply of grenades in the attack.

Practical:

1. Improvement in accuracy and length of throw.
2. Practice in attack and defense.
3. Practice in night work.
4. Practice in night work with live grenades.
5. Practice in methods of blocking a trench.

BOMBING SYLLABUS.

First Day.—Introductory. Organization. First Classification Throwing. Care and Handling Explosives. Various Types of Grenades.

Second Day.—Smoke and Gas Bombs. Group Drill. Bombing Over Traverses. Trench Engines and Throwing Devices. Second Classification Throwing.

Third Day.—Grenades in Attack. Attack on Trench System (2 hours). Grenades in Defense. Defensive Organization.

Fourth Day.—French and German Grenades. Third Classification Throwing by Groups. Training Rifle Grenades.

Fifth Day.—Supply. Storage. Trench Organization. Clearing and Blocking Trench. Resumé of Course.

Sixth Day.—Oral Tests. Throwing Tests.

Grenade Throwing.—First throw, a distance of 20 yards; second throw, a distance of 25 yards; third throw, a distance of 30 yards.

Dimension of Target.—Six yards diameter. Bull 2 yards, 3 points; inner 4 yards, 2 points; outer 6 yards, 1 point.

Test at Each Distance with Seven Dummies.—To pass the following points must be obtained: First distance,

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15 points; second distance, 15 points; third distance, 12 points.

STANDARD (BRITISH ARMY) TESTS FOR BOMBERS.

Position: Standing in a trench or cage 4 feet wide and throwing over a traverse 6 feet high. The bomber is allowed to jump up, to get direction before throwing, but no mark indicating direction may be used.

Targets:

Three cages (see figures 3 and 4).

One cage (a) in front at distance of 25 yards.

Two cages (B and C) on each side at angle of 45 degress to thrower's position and 20 yards away.

Test: Bomber starts with 15-pound dummy Mills grenade. He starts by throwing into cage (A); as soon as he has got three in he goes to cage (B) with balance of unused grenades. He throws till three are in (B), then goes on to cage (C), and can expend balance in getting two into cage (C).

If the number of grenades is expended before two grenades have been thrown into cage (C), he fails to qualify.

Second Test: Three fire grenades to be thrown at a target, examining officer to decide man's capability.

Third Test: Rifle grenade (No. 23) to fire five grenades, three of which must hit a target consisting of a trench 20 yards long and 4 feet wide, at a distance of 70 to 90 yards. Same mark fired from behind a traverse.

Fourth Test: Bombers to be tested working down a trench. Each man will answer questions as to duties of each member of the squad.

Fifth Test: Conducts verbal examinations on bombers and rifle grenades lectured on, including smoke grenades and candles and German grenades.

Tests are carried out under strict supervision of a brigade bombing officer.

Dress Worn for Test: Drill order, with hamsock, water bottle and entrenching tool, but without rifle.

In the following pages are shown the common types of bombs and grenades in use, and with which one should become familiar.

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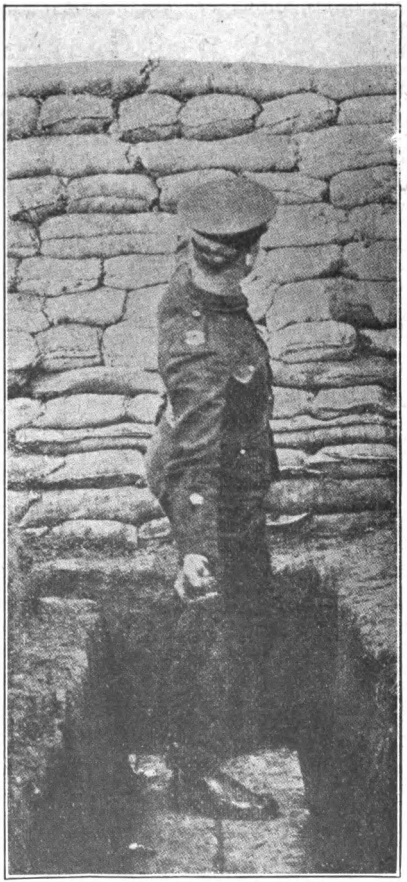

FIG. NO. 3.

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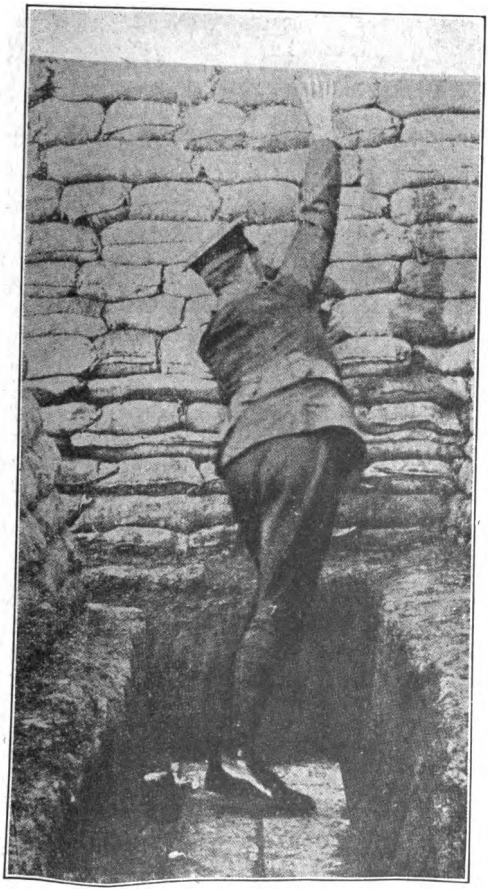

FIG. NO. 4.

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ALTERNATIVE STANDARD TESTS.

Before a N. C. O. or man can be classified as a "trained bomber," he must have qualified in the standard tests laid down. These tests must be strictly carried out—under special arrangements, if possible—as by this means only will the necessary high standard of efficiency be attained.

All N. C. O's. and men classified as "trained bombers" will be entitled to wear distinctive grenade badge.

PART I.

First Test.—Object being to test the accuracy of throwing. Dummy grenades to be used.

1. Thowing in the open from measured distances into a trench.

   Two positions:

   (a) Standing in the open at 30 yards; 10 grenades, 5 to land inside the trench.

   (b) Kneeling in the open at 20 yards; 10 grenades, 5 to land inside the trench.

   The trench to be 4 feet wide, 3 feet deep and 10 feet long, end-on to the thrower.

2. Thowing from a trench or breastwork 4 feet wide, 4 feet 6 inches high, into trench (same dimensions as in 1).

   Standing 20 yards; 10 grenades, 5 to land inside the trench.

3. Thowing over traverses into fire trench. Standing in the trench and throwing over one traverse and then over two traverses into the fire trench 4 feet wide. Traverses to be 6 feet high and 10 feet broad and 15 feet apart.

   Number of dummies to be thrown:

   Over first traverse, 6 grenades, 5 to fall into fire trench.

   Over two traverses, 6 grenades, 3 to fall into fire trench.

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PART II.

Final Tests:

1. (a) Stripping grenades of each type.
   (b) Six questions on "Properties of Grenades—Detonators—Fuse and Lighters."
   (c) Six questions on "Care and Handling of Grenades."
   (d) Six questions on "Trench Tactics."
2. Live grenades to be used.
   Thrown from same trench and under same conditions as in Part I (2).
   Six grenades (assorted) to be prepared and thrown.
   Three to fall inside the trench.

No. N. C. O. or man will be allowed to commence Part II until he has qualified in Part I.

He will be classified on Part II only.

If he fails twice in Part I he will be put back for further instruction.

Names of N. C. O's. and men who are classified as "trained bombers" should be published in battalion orders.

Standard Tests, Part II, for classification should be carried out by brigade bombing officers.

GRENADE CARRIERS

The following patterns of grenade carriers have been found generally useful:

(a) Bucket Carrier.—This is a bucket of khaki canvas with double bottom. It is carried by a sling of adjustable length, and will hold 20 Mills grenades. It is closed by a cord.

Care should be taken that the safety-pins are not bent when grenades are carried in a bucket.

(b) Belt Bag Carrier.—A canvas bag with steel hook, to be carried on waistbelt and hold four Mills grenades. The bag is closed by a piece of cord.

Various other types are in use.

(c) Waistcoat pattern, with pockets, to carry 10 Mills grenades.

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SUGGESTIVE COURSES OF TRAINING.

The following is suggested as a suitable course of instruction for the infantry of a training division in order that they may familiarize themselves with the conditions in France and be given the very necessary training in elementary engineering:

1. Lay out a brigade sector with firing line, support line, reserve line, main communication trenches, company headquarters, battalion headquarters, dug-outs, ammunition and bomb stores, rifle racks, latrines, etc.

2. Have the trenches dug under sapper supervision, and all battalions exercised in digging and riveting. The infantry to be particularly exercised in the rapid filling, and laying correctly, of sand bags, and building of traverses and all types of riveting.

3. Have the firing line and support line wired with various types of wire entanglements, including high and low wire entanglements, with wooden stakes, screw iron stakes, angle iron stakes, knife rests, aeroplane hurdles, "gooseberries," concertina barbed wire, French wire, with loose barbed wire placed through it.

4. Have a few dug-outs of each type placed, but have all the necessary facilities provided. Give special instruction in the protection of dug-outs against gas clouds.

5. Have signal communication placed from brigade headquarters to battalion headquarters to company headquarters and signalers' dug-outs provided.

Have the trenches occupied. Battalions to live in the trenches, practice reliefs, carrying in of rations, water, stores, etc., cook their food in the trenches and remain there for fixed periods. (About 36 hours.)

6. Have the machine gun companies trained in the citing and construction of strong dug-outs for machine gun crews, and open and protected machine gun emplacements. Have trench mortar personnel trained in the citing and construction of trench mortar emplacements, ammunition dug-outs, etc., etc.

7. Practice attack on the trenches. Destroy the wire and trenches with trench mortars. Attack and consoli-

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date the trenches, reversing them to fire the other way. Particular attention should be paid to the training in the rapid consolidation and reversing of trenches demolished by shell fire or otherwise. Particular attention should be paid to the rapid digging in by infantry, of a new line of trenches, without sapper supervision. For both these tests a time limit should be fixed.

8. **All work, as far as possible, should be carried out at night.**

9. Infantry officers and senior N. C. O's. should be specially coached in the following:

(a) Map Reading.—Particular attention should be paid to training in how to select a route from one point to another from the map.

(b) Leading their men in platoons, working parties and carrying parties across rough country at night to unknown points, using compass and map.

(c) Distributing men on the work, with their tools, and how to set them working.

(d) General dimensions of trenches, that is, width, depth, traverses, etc. Tasks. The responsibility of the infantry garrison for the upkeep of the trenches, for the amount of work done and how much work they should get out of their men under ordinary circumstances.

(e) The various types of trenches, and riveting materials required and engineer materials likely to be available—how they are obtained—from whom and through what channel.

(f) Various types of wiring, and how wiring parties are distributed and work, prepare their wire and place it.

(g) Dug-outs, types, methods of erection or construction. Cover required against shell fire. Why dug-outs resting on sand bag walls are useless. Construction and protection of sniper's posts and observation posts.

(h) Explosives, elementary knowledge of guncotton, ammonial tubes, detonators, fuses, etc. How to

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place them to blow up machine gun emplacements. Trench mortar emplacements. Machine guns, dug-outs, traverses, wire entanglements, dud shells, etc.

(i) General principles to be observed in citing trenches, as regards field of fire, concealment from view, and drainage. Why good drainage is essential.

9. It is considered that a programme such as this can be attempted and carried out without any difficulty. It is the first problem the infantry have to attempt on entering the trenches. Training along these lines is considered to be, under the circumstances, of equal importance with other training. If the infantry exercises in this work, under peace conditions, it will familiarize them with the conditions under which they must live during the whole period in the trenches, and it will prove invaluable to new units or drafts coming to this country.

Action in Throwing.—The grenade is thrown as a cricket ball would be thrown, and the action is that of overhand bowling.

The right-hand thrower turns the body half right, the right hand drawn back and below the waist, arm straight. The left foot is advanced, the weight of the body being carried on the right foot, body bent back, eyes held on the object aimed at. (See Figure No. 1.)

The grenade is thrown with a circular swing of the right arm over the right shoulder, the weight of the body shifting from the right to the left foot, every muscle being exerted in the throw. (See Figure No. 2.)

For a throw to be perfect, the grenade should leave the highest point of the hand and well into the air. Practice should also be made from deep dummy trenches, where the grenade is thrown with a bent arm, as good position in actual fighting cannot be chosen at will.

Distance is most important in throwing, but accuracy is more essential, as the greatest waste and danger may result from bad throwing.

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FIG. NO. 1.

ACTION IN GRENADE THROWING

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FIG. NO. 2.

ACTION IN GRENADE THROWING

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Bearing this in mind, the men, even in the first practice, should be made to aim at some definite object.

When demonstrating the No. 5 Mills hand grenade to the men, they should be constantly told that should they accidentally drop one in the act of throwing, there is time enough for them to pick it up and throw it from the trench or barrier.

Those men who are not picked or reserved for the more advanced bombers should not be considered capable till a knowledge of the following is mastered:

A. Have a practical knowledge of mechanism and use of the Mills grenade.

B. Be capable of throwing a Mills grenade to a distance of 30 yards from a trench.

C. To throw a live grenade to give himself the proper confidence.

D. Have a fair knowledge of how a squad conducts itself in fighting along a trench in attack and defense.

Those reserved for special training are taught the following:

A. Use and mechanism of all common types of bombs.

B. Use and methods of trench catapults, guns, etc.

C. Knowledge of rifle grenades and their use.

D. Storage and care of grenades in and out of the trenches.

E. Have the knowledge of how to train squads for different methods in attack and defense.

RIFLE GRENADE WORK

The training in the use of rifle grenades should insure proficiency and rapidity in:

(a) Aiming both with stand and pendulum sight.

(b) Ranging and observation of fire.

(c) Preparing emplacements for the stand.

(d) Firing from trenches with a pendulum sight.

(e) Fire at a vertical target.

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Suitable equipment for a rifle grenade squad of one N. C. O. and eight men is:

4 rifle stands.
8 pendulum sights.
8 special waistcoats for rifle grenades.
1 periscope.
A squad can thus carry 160 grenades.

The tactical training of a squad should include instruction in:

(a) Movements in the open or in trenches.
(b) Concentration of fire on a given point in a trench network.
(c) Distribution of fire along a trench either by groups or single shots.
(d) Rapid changes to fresh targets.
(e) Dispositions to assist consolidation of captured trenches.
(f) Use against vertical targets, M. G. emplacements, etc.

The greater part of this training should be carried out in the form of drill rather than actual practice; the squad should be fairly proficient before such practice takes place. "Live" rifle grenades need only exceptionally be used for practice. Dummies or service grenades, with detonators removed, should be used instead.

DUMMY TRENCHES

For the training of bombers an attempt should be made to practice the men as they complete the preliminary work under service conditions. For this purpose dummy trenches of four or five fire boys with traverse should be made. For bombing squads to practice throwing, blocking, etc., bombing pits should also be dug and the men constantly practiced in these.

Whenever possible, where a good system of trenches are constructed, the men should be put in for a whole night observing war conditions and should carry out practice raids, sorties, attacks and defensive schemes. This will be found invaluable, and as a rule is taken up

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enthusiastically by the men concerned. When the live grenades are available, night work should be practiced and the men should be taught thoroughly the use of the rifle grenade.

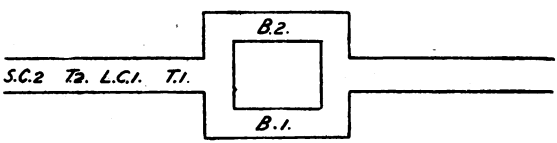
Sufficient training in grenade throwing with full equipment and to get the men accustomed to this under active service conditions should be constantly practiced.

Method Adopted When in Action.—The bayonet men work around the traverse until stopped or checked. The leader then directs T. 1 to open fire. This thrower throws grenades as fast as possible into the enemy section.

On receiving word to report, thrower stops and bayonet man moves forward to see into next bay. If clear, word is passed back and the whole squad move forward into the next bay and take up a like position at traverse 3 and thus continue to advance, casualties being replaced as they occur.

When a communication trench is encountered, leader is notified and decides what action to take. Usually word is sent for another squad, which will work down this new line. When an island traverse is encountered the following method is adopted while the thrower bombs out the advanced portion. (See Sketch "K.")

During the training of the men and after they have mastered the first important step, they can co-operate in practice with the Lewis gun and Stoke gun crews, and evolve different schemes in which these guns protect the advance of these squads.



SKETCH "K."

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Bombers in the Attack.—Bombers are employed in different ways, depending on circumstances, but their usual work comes under the following:

1. Raids on the enemy trenches, where the intention is to inflict losses on the enemy and destroy works, but with no intention of holding a captured position.

2. Local attacks in conjunction with bodies of infantry to capture and hold some length of trench.

3. General attacks on a large scale, where bombers are allotted various and special tasks, depending on the general scheme of operations and the objective to be reached.

In the preparation for an attack, all information and details of enemy trenches and objective must be thoroughly gone over. Aeroplane photographs taken over the trenches must be carefully studied, so that proper provision can be made for all points beforehand.

For all points in their system of defense, special attention must be paid for bombing provision for all side trenches, etc.

The following sketch is a portion of the German line at a position west of Aubers and shows the many trenches, communications and otherwise which in this case would have to be provided for when organizing for the attack.

(See Page 25.)

When the general operation orders are studied, the organization for the part to be taken by the bombers is carefully studied out. Separate parties must be detailed for each side trench and communication. If the air pictures are not clear enough, a sufficient provision of parties must be made and they will be numbered off as side parties No. 1, No. 2, etc., and used when required.

Trench mortar and machine gun officers will co-operate as much as possible for the protection of these bombing parties and to make gain ground faster by smashing resistance. The Stoke guns are specially valuable for this work.

They usually concentrate their fire at a point about 50 yards beyond the length to be secured by the bombers.

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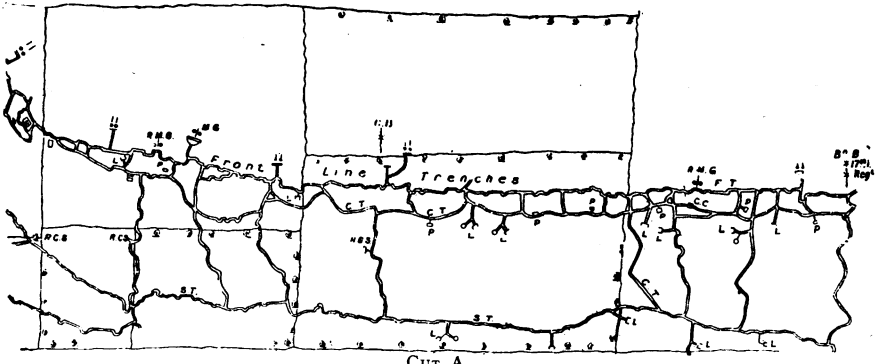
Position of 2nd Battalion, 13th Regiment, VII Corps, West of Aubers. (Sketch found on German officer captured.)



CUT A.

REFERENCES

F.T. = Front line trenches.
S.T. = Support trenches.
C.T. = Communication and inspection trenches.
L. = Latrines.
P. = Pits for drinking water.
M.S. = Mine shafts.
= Mine galleries.
W. = Wells.
L.P. = Listening Posts.

M.G. = Machine gun emplacements.
R.M.G. = Reserve machine gun emplacements.
Bn.B = Battalion boundaries.
C.B. = Company boundaries.
F.S.S. = Flag signalling station.
H. = Houses (Ruins).
= Hedges and ditches.
= Lines of trees and willows.
D. = Dug out.
H.G.S. = Hand Granade Store.
C.C. = Company Commander.
S.C. = Section Commander.
R.G. = Rifle Grenades.
R.C.S. = Reserve Cartridge Store.

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These guns fire on carefully registered targets, and only cease fire after the captured position has been consolidated.

Where observation is favorable, the Stokes gun can fire down the trench ahead of the bombers, thus assuring a clear trench, but this should only be done when the observation officer has a clear view of the position.

Bombers When Attacking Across Open Ground.—For a general attack launched from our trenches against enemy trenches, the bombers are organized for the following duties:

A. To dispose of enemy in trenches over which the assault has passed.

B. To block communication trenches where necessary as a means of defense.

C. To assist the infantry at points where the resistance is strong and is holding the attack back.

D. To wipe out with hand and rifle grenades enemy machine gun positions.

E. To clear all enemy dugouts of prisoners and deal with points of resistance.

The position of bombing squads depends in the attack on what duty has been allotted to them.

The clearing parties for the first trenches should follow the leading waves of infantry, while parties for more forward trenches should follow second and third waves. Squads to deal with communication trenches follow in rear of first wave and deal with trenches when final objective is reached.

Company bombing squads should be on company flanks in the attack ready to reinforce any weak point along the company frontage.

Equipment of Bombers in the Attack.—During raids and grenade operations all throwers should be as lightly equipped as possible and should not carry rifles, but should have revolvers and carry a bayonet or stabbing knife, or some weapon such as a weighted stick for hand-to-hand fighting. The other men will all carry slung

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rifles. During a general attack all men will generally carry rifle and bayonet. Bombers should therefore practice throwing with rifle slung over left-hand shoulder.

The best method of carrying grenades is in a canvas bucket or haversack, which hooks to belt.

Supply of Grenades During an Attack.—During an attack, when bombers must have a constant and unending supply of grenades, a positive system of supply must be arranged and is usually done as follows:

Bombing depots are arranged for all along the front line at suitable intervals, at points in the communication trenches and in the support and reserve trenches.

During the attack a chain system is established. Men are placed at intervals along the trenches from front to rear and the grenades in bags or buckets are passed up by hand, this chain extending as the attack advances.

Where attempts are made to keep up a supply by sending men back for them a break usually occurs.

The chain method sometimes means a great loss of men from artillery fire, so that where it is thought advisable a company may be detailed for this duty who will adopt schemes to keep up the supply at all times.

Responsibility is necessary from point to point and is usually placed as follows:

Brigade bombing officer, responsible for supply of brigade supply to battalion.

Battalion bombing officer for supply from battalion headquarters dump to firing line.

Company commanders, from firing line to all captured forward positions.

All grenades should be stored carefully in depots and all depots should be clearly marked with a sign board.

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The following article written by a captain of the French Army will show some of their methods and practice with bombers in the attack:

Material.—The object of the battle is to defeat the enemy with as little loss as possible to oneself. One must not therefore begin recklessly; there must be no carelessness, except toward the inevitable losses. In order to conquer and live, the smallest details must be carefully attended to.

Knowledge of the Ground.—Before the attack, the nature of the enemy's defenses and the lje of the land must be thoroughly impressed upon one's memory. The position must be familiar from every aspect. This study is of the greatest importance, **especially for the troops of the second line,** because a check to an offensive against a fortified position is too often caused by insufficient knowledge of the enemy's dispositions; advancing troops are perpetually suspecting ambushes and fearing to be entrapped. Company commanders, particularly those of the first line, should impress successive points of direction on their section commanders, so that every one may be aware of the obstacles to be encountered. The men ought also to know the ground well. I used to make them study the future sector of attack by indicating to them, when they were mounting guard in the trenches, the principal points to be examined.

If, on the 4th December, we had been familiar with the ground before our night attack, instead of being absolutely ignorant about it, we should not have waited at the first German trench until the dawn of day so as to avoid falling into a hornet's nest, and we should have taken not only the second trench, but the third also, and should have made numerous prisoners.

Maps.—Before the attack, very detailed maps are distributed to the company and section commanders; but one should try, by constant and repeated observation of one's sector, to fill in the deficiencies oneself. Before

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the attack of 9th May, I had copied out that part of my plan concerning the company's zone of attack, adding all known information for every non-commissioned officer.

War Material.—Real ascendency is obtained over the enemy by the superiority of weapons; courage alone cannot take the place of destruction; the men must be supplied with suitable and useful materials.

Grenades.—Every grenadier or skirmisher will carry five grenades; each man will have one, not to throw himself, but that there may be sufficient in case of need. If a grenade fight in a district intersected with fire or communication trenches is expected, the supply of grenades must be increased. A supply of asphyxiating bombs must be supplied for distribution among the patrols detailed to work up the communication trenches.

All the men must be given as much practice as possible in handling the different kinds of grenades. (On 9th May, I sent back 5 kilometres to fetch asphyxiating bombs of which I had just heard in order to learn the effect of this useful weapon.)

The hooks fixed to the left wrist, to set the fuses of the grenades, should be got ready. Revolvers and knives are indispensable for fighting in communication trenches. Sandbags should be supplied to each man, for the purpose of rapidly making a barricade in communication trenches or for forming a shelter, as already explained.

"Filloux" apparatus should be supplied and every one should know its use.

Equipment.—The knapsack should be worn, as it will be useful for protection against the bombardment of the captured positions which will ensue. For instance, the blanket if folded and put inside the sack will form a protection against splinters. (The affair at Langemarck, 4th December, affords an example of this.)

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SUGGESTED GRENADE SUPPLY DURING A BIG ATTACK.

The importance of proper provision of a continual supply of grenades during a big attack should be realized, and the following suggestions have been found to work well:

Advanced storage depots should be established all along the front line, at positions along communication trenches, and in support and reserve lines, with battalion supply depot in rear. This to be kept replenished from brigade depots.

As soon as possible after an attack, supply depots should be established in the captured enemy positions, and by the chain system, or by special carrying parties, a continual supply sent forward to these points.

The supply to be carried by the first assaulting waves should be adequate. With this object in view, each man in the assaulting lines should carry at least three grenades.

Indiscriminate throwing should be checked as much as possible.

It is most important that all bomb depots should be clearly marked, as otherwise confusion and loss of time might follow.

In making provision for grenade supply during an advance, the possibility of being cut off from the rear with its supply bases should always be considered and arrangements made accordingly.

The bombing squads will carry as many as can conveniently be carried, but should not be allowed too many, as any overload will be thrown aside by the men once they start.

All troops going forward will turn over their grenades for use in depots made in captured enemy positions.

Special carrying parties must be detailed as spare carriers at each depot, and a special supply of carrying canvas buckets be kept on hand at each place.

Supporting troops sent forward should also carry a fresh supply of grenades.

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All bombing depots should be roofed over as much as possible for protection from shell fire.

When bombing stores are found in captured trenches, these bombs should be examined and used as much as possible, thus making a saving in the use of our own grenades.

The best method is to have all captured grenades sent to a central depot for examination and distribution.

DISTINGUISHING MARKS WORN DURING AN ATTACK.

It is most essential during an attack, to prevent confusion and loss of time, that all branches and units have a proper distinguishing mark to make identity easy.

All the different battalions and companies should wear some different badge in some conspicuous place on the arm. And in the case of specialists, carrying parties, etc., special bands of cloth of different colors, about 2 inches wide, could be worn around the right arm and, if possible, lettered.

The specialists usually chosen to wear these bands are:

Scouts.
Runners (or messengers).
Battalion and company signalers.
Carrying parties.
Mopping up parties.
Salvage parties.

BOMBERS IN THE DEFENSE OF A SYSTEM OF TRENCHES

When the enemy have made an entrance at some portion of our trench, an operation on a large scale, depending on. circumstances, may be organized to drive them out again.

The following organization should be adopted and has been found very successful.

The parties are divided in the following way:

The point.
The support.

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The side parties.
The main body.
The duties of the above are as follows:

The point:

This party, which launches the actual attack, consists of one complete bombing squad (one N. C. O. and eight men). They attack along the trench as already laid down by a series of rushes. Where there is room, all throwers will throw simultaneously, being supported by the rifle grenade men. The enemy should not be allowed to stop for a stand.

The support:

This consists of a complete squad, who will supply men to replace casualties in the "point" and will clear what dugouts are encountered. When the point is held up or checked, they may leave the trenches and work around, taking cover in shell holes, etc., and try and relieve the pressure on the point, but must be careful not to run into the fire of the supporting machine guns. In the event of side trenches being encountered, they will hold these until the arrival of a side party or squad.

The side parties:

The work of these parties is distinctive and they are not used as reinforcements. Each party is numbered and deals with side trenches detailed for.

Other side parties may work on blocking certain trenches and in picketing other trenches.

Two parties only should move in front of the main body.

When blocking is necessary, working parties with proper material, sandbags, etc., are sent up from main body.

Parties are directed to their particular trenches by an officer who is specially detailed for this work.

The main body:

They will keep the support up to strength, will keep a constant supply of grenades by a chain system to the fighting point from the bombing depots, and will consolidate all recaptured portions of trenches.

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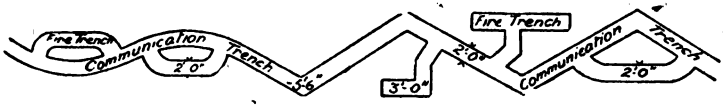
Machine guns will accompany the main body with Stokes motors when possible.

FOR DEFENCE OF COMMUNICATION TRENCHES

Fire trenches to defend communication trenches should be made as indicated below, rather than by widening the trench and cutting a fire step.



SKETCH "D."

Blocking of Trenches.—Blocking of trenches is used very greatly, especially when on the defense, as a means of keeping the enemy at bay.

A block is a barricade of some description which is put across the trench to keep the enemy from further advancing and to keep them beyond a point where they can throw grenades.

Blocking can be done either by the use of explosives in blowing down a portion of trench or by the use of barbed wire and obstacles in conjunction with sandbags. Another method is to fill in the whole section of trench with earth.

When squads work down a trench and it is decided to block, it is advisable to force the enemy (when possible) down the trench 50 yards or so farther than the point to be treated. While the enemy are kept under constant fire, a barricade can be constructed, which is usually of sandbags with barbed wire to hinder enemy from digging out.

There are as a rule two types of trenches which it may become necessary to block. One is a winding trench down which firing is impossible. The other is a traversed fire trench.

The winding trench is blocked as a rule by filling in a complete portion of it, this portion being long enough to

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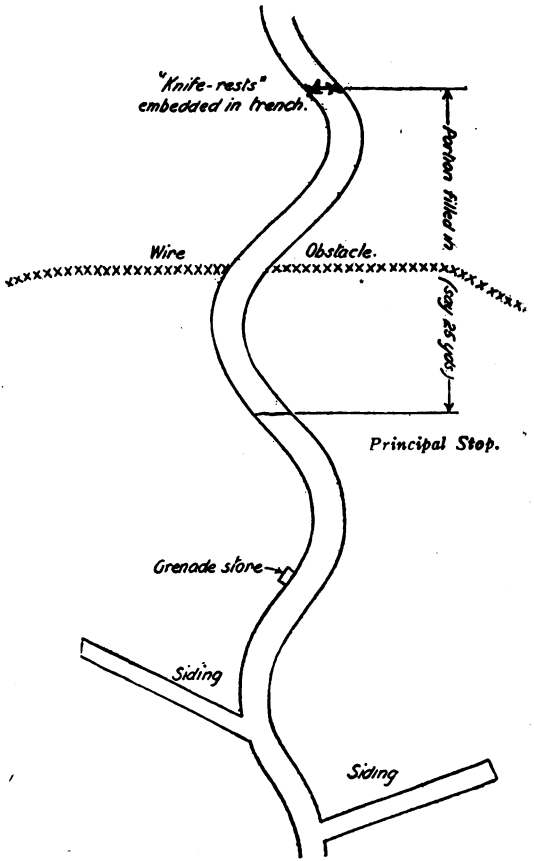

SKETCH "B."

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give ample time to the defense to open fire on any one who may attempt to rush over the top. (See Sketch "B.")

It is useless to fill in a trench for a greater distance than a grenade can be thrown, as it would only be dug out again in safety by the enemy up to the point at which our grenades could be effective.

Barbed wire knife rests set in across the trench and covered up form really good blocks in a trench. These should be kept at intervals in small dug receptacles or chambers at intervals in our own trench ready for immediate use.

When blocks are completed a machine gun placed to sweep the top will be found invaluable and, to make it safer, knife rests can be thrown out.

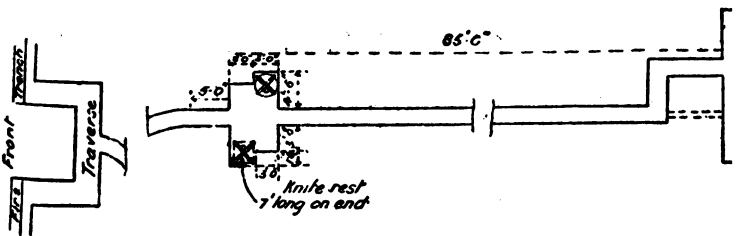

FIG. 11

In the case of a straight trench with traverses, a sufficient number of these traverses should be cut away and the earth used to fill up the recesses. (See Sketch "C.") When a breastwork with loopholes is made across the trench, if the trench immediately behind the breastwork is roofed over, it will serve as a good protection against thrown grenades.

Another form is to project chicken wiring on poles. The grenades strike this, fall and explode harmlessly.

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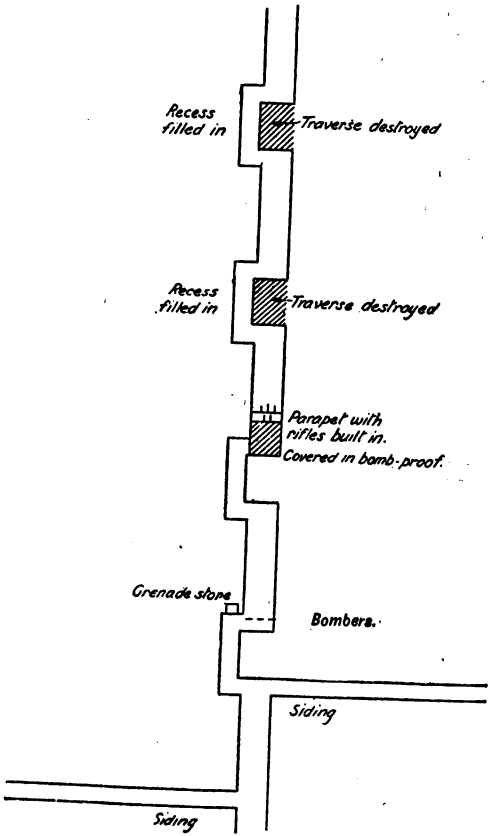

SKETCH "C."

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CARE AND STORAGE OF BOMBS.

All grenades which are stored in trench supply depots should be ready with detonators inserted.

All companies in the firing line should have a number of depots and grenades allotted to them. These stores should always be kept replenished and the responsibility placed on the company and platoon officers, who will make frequent inspections.

One of the best positions for bombproof supply depots is near the head of the communication trenches. Other supply depots should be in trenches immediately in support of the front line for replenishing same.

A satisfactory supply depot is one which runs off the main trench in a "T" shape and is covered over for protection. The grenades should be kept in tin lined boxes, the old ammunition boxes being found very satisfactory.

All grenades should be turned over at regular periods when stored.

Special precautions must be observed to see that no smoking or inflammable material is allowed near any bombing depot, and proper ventilation must be arranged for, as otherwise the grenades are affected by moisture and dampness.

When the detonators are being inserted in the grenades, previous to sending them up to the trench, care should be taken to do this under dry conditions, and a free us of vaseline smeared on plug should be made before screwing same home.

Each company in the front line should have on hand about 500 grenades, with at least 1,000 held in battalion depot.

The following extracts are taken from German orders issued by the 180th Regiment on February 28th, 1916, and tend to show the similarity in their methods with those adopted on the Western Front by the Allies.

In training men for grenade fighting, the following points are to be noted:

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1. During practice with dummy grenades, the thrower must always act as if using live grenades and think of the timing, so that when using live grenades he is able to make the necessary pause. Counting, e. g., "Zwei und zwanzig" (22), "drie und zwanzig" (23), "vier und zwanzig" (24), appears practical. These three numbers give the correct amount of pause necessary.

As a general rule, the grenades thrown are cast too soon. It must be made clear to the bombers that this practice is quite wrong, and can have disastrous results, for the enemy has time to avoid grenades or throw them back or to one side, as the case may be.

2. When the bombing squads of the platoons are fully trained, a second squad of each platoon is to be formed and trained. The first and chief bombing squads of platoons are, however, to be given further training every 14 days. Lieut. Helferich will report to me when he considers the bombing squads of the various companies fully trained. I shall then take steps to verify this.

3. The bombing squads and also the first squad of the bombing platoon are to be armed and equipped as follows:

Nos. 1-4. Pistol, dagger and 6 grenades.

Nos. 5-8. Rifle, 6 grenades and 25 sand bags each.

A squad will be as follows.
No. 1. Thrower.
No. 2. Carrier.
No. 3. Thrower.
No. 4. Carrier.
Nos. 5 and 6. Carriers.
L. Leader.
Nos. 7 and 8. Spare men.

It is essential to keep the men extended in order to facilitate freedom of action and to enable them to dodge the enemy's grenades, but care must be taken that cohesion is not sacrificed in consequence.

Each squad must be trained so that every man can take the place of any other in it.

The leading man (No. 1) only will throw; the carrier (No. 2) will prepare the grenades.

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Two cases may arise when Nos. 2 and 3 will also throw:

A. At the moment of making an attack in order to surprise and confuse the enemy with a sudden shower of grenades.

As soon as the attack is in progress, Nos. 2 and 3 will cease throwing.

B. When the resistance is too strong for the leading thrower to overcome it by himself.

5. The sand bags carried by Nos. 5 and 8 serve for the rapid construction of a barricade, which is held with rifles.

One man with his haversack straps can easily carry 25 sand bags on his back and, with rifle slung, experience little inconvenience.

8. Supply during an attack across the open.

If the first wave of the assault has succeeded in entering the enemy's trench, communication to the rear must be kept up so that sand bags, containing about six grenades each, can be passed forward continuously.

Supply in the Trench.—No. 1 (thrower) will only use the grenades which are passed up to him, never his own, which must be kept as a reserve for an emergency.

In grenadier platoons, every squad, except the first, must be provided with a small box of grenades, or with three or four sand bags containing six grenades each. The passing up of grenades should be thoroughly practiced.

(Signed) FISCHER.

THE FOLLOWING CAN BE USED AND APPLIED FOR PROTECTION FOR BOMBING DEPOTS.

The construction of overhead cover in all trenches generally may be classed as grenade proof, splinter proof and shell proof (5.9 inch). As cover against grenades, any roofing, e. g., timber or corrugated iron, with 1 or 2 feet of earth, according to its nature, is sufficient.

For splinter proof cover there should be one or more layers of timber props, 9-inch logs, rails or girders, or a foot or more of broken brick, or 9 inches of concrete,

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covered with 2 or 3 feet of earth. Sufficient earth padding is necessary on each surface of concrete so that proper protection is afforded from flying pieces of concrete when damaged by artillery fire. The following is considered one of the best proofs against 5.9 or 6-inch high explosive shell:

Thin layer of earth, 6 or 9 inches.

Bursting course of hard material (9 inches of stones, ferro-concrete slabs, or if nothing else is available, 12 inches of broken brick or a layer of logs).

Earth cushion, 2 to 4 feet.

A resting course, logs or rails, wired together to form a mattress.

Earth cushion, 1½ to 3 feet.

A roof timber, corrugated steel, iron or concrete.

Sub-structure (a strong framework of timber or a corrugated steel shelter to support the inner roof).

Dug-outs which are approximately 20 to 30 feet under the ground, if heavily timbered, are considered shell proof.

BOMBING PARTIES.

(Translation of a German Document.)

3rd Battn., 235th Res. Inf. Regt.

The bombing party (handgranatentrupp) operates, as a unit, chiefly in the trench itself, its action being both offensive and defensive; the manner in which it should be stationed and distributed, employed, armed, led and safeguarded, must be regulated accordingly.

Men selected for this work should be courageous and expert hand grenade throwers. They should wear a distinctive badge. In each platoon there is a bombing party consisting of six men, including their commander. When one of these men becomes a casualty, a substitute should be ready to take his place. The bombing party should be stationed approximately in the center of the platoon. Boxes containing grenades should be placed near the party; they should be clearly marked as containing grenades and should be reserved for the use of the party in the first instance.

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(a) Should the enemy have penetrated in a **small** portion of the trench, and should the troops on the spot not be able to deal with them by means of the bayonet or hand grenades, the bombing party should, without waiting for orders, immediately attack the enemy with grenades before it becomes necessary to erect a barricade in the trench. On a signal from the commander, the men of the grenadier party equip themselves with hand grenades and collect round him.

All men of the party carry their rifles slung, bayonets fixed and daggers ready, with the exception of the two leaders, who do not carry rifles. The latter carry as many grenades as they can conveniently handle and should, if possible, be armed with pistols. The commander, similarly armed, follows the two leading men. If no pistols are available, the commander, who should cover the two leading men, carries his rifle in his hands, ready loaded. The remaining three men follow the others a traverse in rear; they keep within sight of their commander, and carry as many grenades as possible. When possible, the grenades are carried in their boxes. The two leading men advance along the trench in a crouching position, so that the commander can fire over them. The interval between traverses is crossed by a rush.

(b) If the enemy has penetrated into the trench with a **large** force and a continuation of his attack is to be expected, as good a barricade as circumstances permit should be erected. The bombing party should at first remain on the defensive in rear of this barricade or behind a breastwork. Rifles should be unslung ready for use. The commander and the three rear men should take up their position behind the nearest traverse and within sight of the two leading men.

Bombing parties belonging to the platoons in support and in reserve should be stationed somewhere in the vicinity of the communication trenches, and should be brought up to a strength of eight men, including the commander.

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GATE BLOCKING IN A TRENCH.

A gate arrangement used as a block at intervals along a trench will be found a good means of holding the enemy back temporarily should they gain an entrance to the trench.

This gate is constructed of a framework the full width of the trench, with a gate of sufficient size which will swing on hinges from the top and can be swung up when not in actual use, is made to lock on either side and can be quickly lowered into position.

CLEARING OR MOPPING UP PARTIES.

The preliminary organization of these parties should be carefully "gone into" and every precaution taken.

The strength of these parties depend on circumstances, and in some cases may go as high as 25 per cent. of the assaulting force.

If the intention of the assaulting troops is to push forward over lines of enemy trenches, parties or squads of these bombers should go forward with each assaulting wave, and as these waves cross each line of trenches, the bombers will drop in these trenches and clear out the enemy from his dug-outs and shelters.

Other parties will deal with dug-outs constructed beyond these trenches.

Great care should be taken when clearing dug-outs, to post a sentry or picquet at each entrance to avoid casualties by mistake from other parties who might select the same shelter for operations. In this respect it must be remembered that nearly all German dug-outs have two or three entrances.

Shell holes form a very good shelter for Germans with machine guns, so that proper provision for clearing these must be made.

Clearing up parties must be impressed that their work is to deal with these dug-outs and not to push forward with the advaancing troops.

Mopping up parties for work in captured villages is especially necessary, as the opportunity for shelter for machine gun work and sniping is especially good here.

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BOMBERS IN THE DEFENSE.

Grenadiers in the defense of a system of trenches can be greatly utilized, but the main defense of the trenches is by rifle and machine gun fire.

A proper distribution of bombers should be made along the whole front line.

Special bombers should, in the event of the line being entered, bomb the enemy out from bombing pits, which should run to bomb throwing distance of the front line.

Where positions to the front provide ground which rifle and machine gun fire do not cover, such as shell craters, sap heads, hollows in the ground, etc., bombing posts communicating with the front line should be established to prevent the enemy from occupying these portions of ground.

The trenches running forward to these bombing posts should have overhead cover of wire mesh. This will prevent the enemy from throwing from their portions of trench if taken.

Bombing posts should be established at two or three points in the front line at each sap running forward. In the event of the enemy trying to force their way down this trench, bombs can be launched at them from these points simultaneously.

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HISTORY OF GRENADES

Grenades are of great antiquity. They were used in 1427 at the siege of the fortress of Casalmaggiore on the River Po, where the defenders threw bottles filled with gunpowder, a primitive form of grenade. They were largely employed during the seventeenth and eighteenth centuries.

In 1665, during the reign of Louis XIV., grenades were carried in a pocket called a grena-diere, and it soon followed that picked soldiers who scoured the country in advance of the line of march became known by the name of grenadiers. At first there were only four grenadiers to each regiment of infantry, each of them carrying twelve to fourteen grenades. After the year 1670 companies of grenadiers were formed who a few years later were armed with muskets.

The word grenade really means an explosive shell fired from a gun, and this meaning survives in the German word, Granate. Grenade throwing as a drill was regularly practiced in the English army until about thirty years ago.

Grenades lost their importance during the Napoleonic wars, but were employed at Saragossa (1808-9), Antwerp (1832), and Sebastopol (1854-56). At the latter place the French threw some 3,200 grenades, while they were also employed by the Russians. The Russian grenades were about 4 inches in diameter, being made of cast-iron. Some were made of glass, and consisted of a bottle of special shape filled with gunpowder having a fuse attached to it.

Hand grenades were used for close combat in the assault or defence of works. They were merely small shells made of castiron or thick glass containing an explosive fired by a fuse. They weigh about 3 pounds, and can be thrown by hand from 20 to 30 yards.

This ancient engine of war had almost completely fallen into disuse amongst European armies until the Russo-Japanese War (1904-5), when it regained much of its old importance. It was found that the grenade was the only arm which could effectively reach the enemy in his trenches from a short distance. They were first employed at the siege of Port Arthur,

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and became gradually the chief weapon for hand-to-hand fighting.

The Russian hand-grenade consisted of old cannon-balls or rolled brass cases of quick-firing artillery cut into lengths of 4 inches. They were filled with dynamite or pyroxil, and provided with a fuse set to burn 15 seconds. The Japanese used ordinary tin preserve boxes of bamboo canes filled with about one pound of pyroxil, which was afterwards replaced by picric acid. An ordinary Bickford's fuse, consisting of flax treated with gunpowder, was used to ignite it.

In the early stages of the war it often happened that the fuse burnt too long, so that a Russian grenade that had fallen among the Japanese was thrown back again before it had exploded. At first the fuse was lit by an ordinary wick or match, but after some time a hole of peculiar shape was introduced.

The Japanese soldiers carried the grenades in pouches hung by ropes round the neck, while a special wick was fastened to a belt round the body. This wick was lit before the attack, and used for igniting the grenades before throwing them. The Russians, who were great believers in hand grenades, established three great factories in Port Arthur capable of turning out a thousand daily.

Considering the experience gained during the Russo-Japanese and the last Balkan war, it caused no surprise that as soon as trench-fighting commenced the hand-grenade reappeared.

The modern grenade is very much like a miniature high explosive shell. The body consists of steel or cast-iron, containing a charge of T. N. T. or other suitable explosive, and a detonator fired by a fuse, which is arranged to fire on impact, but can only do so after the grenade has travelled a certain distance. Premature explosion is thus practically impossible. If a time fuse is employed, it must be so arranged that it can only become active after it has been thrown. Cases have occurred where the grenade exploded before it had been thrown, owing to the fuse acting too quickly.

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GRENADES

GRENADE, HAND, NO. 5, MARK I, OR MILLS' HAND GRENADE (TIME).

Weight complete, 1 lb. 6½ ozs. (See Plate No. 1.)

Description:

Body.—Cast iron, serrated to provide numerous missiles on detonation. Into one end is screwed a center piece with separate recesses for the striker and detonator.

The striker is kept cocked against its spring by its head catching on the end of the striker lever when the latter is lying against the body of the grenade.

The lever is retained in this position by the safety pin.

Igniter.—This is a separate unit, consisting of cap, cap chamber, safety fuse and detonator. (See detonator.)

On withdrawal of the safety pin, the lever swings outward under the pull of the striker spring, thus releasing the striker which fires the cap. The safety fuse burns about 5 seconds and then fires the detonator.

Instructions: To Prepare for Use.—1. Examine the safety pin and see that it is easy to withdraw.

2. Unscrew the base plug and insert igniter.

3. Screw in the base plug with the key provided, taking care that it is screwed home. The lead base plugs, which are sometimes supplied, must be screwed in with care, otherwise the projections may be injured.

To Throw.—1. Hold the grenade in the right hand in such a position that the lever is held securely against the body of the grenade by the fingers, with the lever along the second joints of the fingers.

2. Withdraw the safety pin with the left hand, using a hook if preferred, still keeping a firm grip on the lever.

3. Throw the grenade.

Special Precautions.—1. Do not release the lever before throwing the grenade.

2. It is essential that the lever should be held securely

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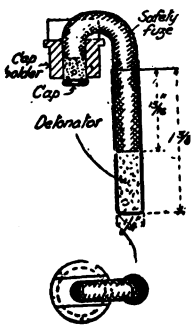
against the body of the grenade, otherwise the collar which holds back the striker may release it and so ignite the fuse.

3. Before inserting igniter, see that the safety pin is not broken or badly corroded, and that the fuse is not cracked or damaged, as these defects may accelerate time of burning.



NO. 5, MARK 1, DETONATOR

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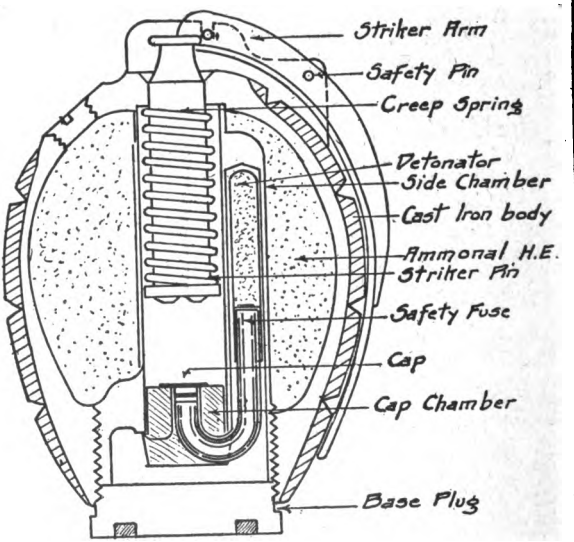
MILLS GRENADE, HAND Nº 5, MARK I.



(PLATE Nº I.)

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HALES' RIFLE GRENADE, SHORT RIFLE NO. 3, MARK I (PERCUSSION).

Weight complete, 1 lb. 5 ozs.

Mean maximum range, 185 yards. (See Plate No. 2.)

Description:

Body.—Serrated steel, filled with explosive. Down the center of the explosive is a brass tube, into the forward end of which the denotator is inserted. The body is closed by the base piece. This carries the striker pellet, two retaining bolts, wind vane, releasing socket and safety pin. To the base piece is fixed a base plug carrying the spring clip and a 10-inch steel rod.

Detonator Holder.—Consists of a special brass tube which screws into the head of the grenade. It is 2½ inches long and contains a detonator and detonator cap. Until the detonator is inserted, the head of the grenade is closed by an ebonite screw plug.

Cartridge.—A special blank cartridge is supplied to fire the grenade.

Action.—The action of the grenade on being fired is as follows:

The wind vane revolves as the grenade travels through the air; after a few turns of the vane, the retaining bolts are no longer held in position by its inner surface and fall out; on impact, the striker pellet sets forward against the creep spring on to the detonator cap, thus firing the grenade.

This grenade is very safe to handle, as it cannot be fired by knocking or dropping on the ground; it must travel through the air some distance before the retaining bolts fall out.

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HALES RIFLE GRENADE, No 3. MARK I
(303" SHORT. RIFLE)

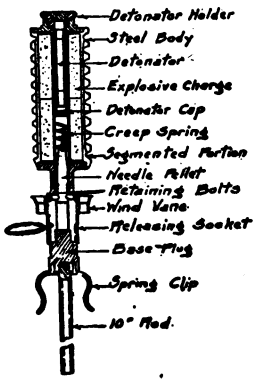

PLATE No 2.

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Instructions: To Prepare for Use.—1. Holding the grenade head down so as to make certain that the needle is not free, remove the ebonite screw plug.

2. If correct, screw in the detonator holder.

To Fire.—1. Lower the rod into the barrel of the rifle, and clip over the muzzle.

2. Load the rifle with the special blank cartridge.

3. Immediately before firing, withdraw the safety pin.

If, after the safety pin has been removed, the grenade is not used, the safety pin may be replaced if the wind vane has not unscrewed and uncovered the two retaining bolts; but if these are uncovered, the grenade is in a dangerously sensitive condition, and if so found, should be destroyed.

Special Precautions When Firing.—1. The grenade should be tapped on the palm of the hand before inserting the detonator, to insure that the striker pellet is properly held in place by the retaining bolts.

2. The wind vane and release socket must not be tampered with.

3. The safety pin must not be removed before the grenade has been inserted in the rifle.

4. The grenade must not be fired with the bullet cartridge.

5. The rod should only be oiled slightly.

MILL'S RIFLE GRENADE NO. 23, MARK I.

Weight complete, 1 lb. 8½ ozs. (See Plate No. 6.)

Mean maximum range (with 6-inch rod), 90 yards.

Description:

Body.—This is a No. 5 (Mills) grenade with a short rod 5½-6 inches long, screwed into the base plug of the grenade. The hole in the base plug is filled with wax or luting when issued, in order to keep the grenade damp-proof in case the rod is not required.

Cartridge.—A special blank cartridge is supplied to fire the grenade.

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MILLS RIFLE GRENADE No 23 MARK I
(Attachment for Firing Mills Grenade From a Rifle.)

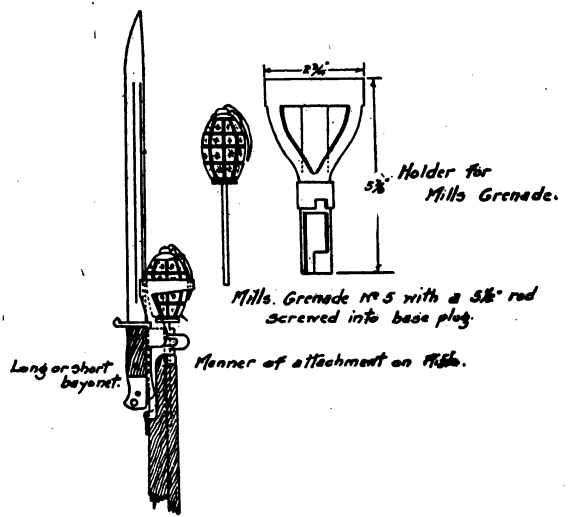

PLATE No 6.

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Ring Attachment.—In order to keep the lever of the grenade in place, after the safety pin has been removed previous to firing, a ring attachment is fixed to the rifle by means of the bayonet; it is so constructed that it can be used either with the long or short bayonet.

This attachment cannot be used with the long rifle (owing to the lack of space between the bayonet and the bore of the rifle); a special attachment is necessary in this case to take the place of the bayonet.

Action.—When the grenade is shot out of the rifle, the lever is no longer held down by the ring attachment, and the normal Mills grenade action follows.

With a 5½-inch rod, the maximum range is 80 yards with the rifle at an elevation of 45 degrees.

Variation of range is obtained by altering the elevation of the rifle. The rifle may be fired from the shoulder or hip, as there is very little recoil.

This grenade without the rod can be used as a hand grenade.

Instructions: To Prepare for Use.—1. Unscrew the base plug and insert the igniter.

2. Screw in the base plug with the key provided, taking care that it is screwed home.

3. When required as a rifle grenade, screw in the short rod.

To Fire.—1. Fix the ring attachment to the bayonet.

2. Fix the bayonet.

3. Lower the rod into the rifle, until the grenade is within the ring attachment and the lever is held by the ring.

4. Load the rifle with the special cartridge.

5. Immediately before firing, withdraw the safety pin.

Special Precautions.—1. When inserting the igniter, see that the fuse is not cracked or damaged, as this may accelerate the time of burning.

2. Lever must be held securely by the ring against the body of grenade.

3. Safety pin must not be withdrawn before the grenade is inserted in the ring attachment.

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4. The grenade must not be fired with a cartridge with bullet, as this may burst the barrel.
5. Rod should be oiled only slightly before placed in the barrel.
6. The rod must be screwed firmly in.

PIPPIN RIFLE GRENADE NO. 22, MARK I.

Weight complete, 1 lb. 9¼ ozs. (See Plate No. 5.)
Mean maximum range, 300 yards. (This is a modification of the extemporized "Newton" grenade.)

Description:

Body.—The grenade consists of a cast-iron stream line body, with a flat head, serrated on the outside, a 15-inch rod is screwed into the pointed end and fitted with a copper gas check. In the center of the flat head is a hole; into this, after the grenade has been filled with "Ammonal," a paper tube with a solid end is forced down and waxed in. This tube takes the special detonator.

Cap.—Over the head of the grenade is a detachable pressed steel cap, the sides of which have been cut away, leaving four projecting lugs, each with a formed hole in it. These lugs fit over four projections cast on the body. The cap is fitted with a safety pin.

Detonator Holder.—This consists of an ordinary 303 rifle cartridge before undergoing the operation of nicking, fitted with a percussion cap only. Inside is an ordinary No. 8 detonator packed around with a waxed paper, with the end spun over. A tin safety strip is fitted to the base of the cartridge case which covers the cap; this must be perforated by the striker before it can reach the cap.

Action.—The grenade, owing to the rod, falls on its head. On coming in contact with the ground, the steel cap is driven up and forces the striker through the safety strip into the cap of the cartridge.

Instructions: To Prepare for Use.—1. Remove the steel cap by the lever supplied with each box of grenades.
2. Push the detonator holder down into the grenade, until the rim of the cartridge case comes in contact with the body.

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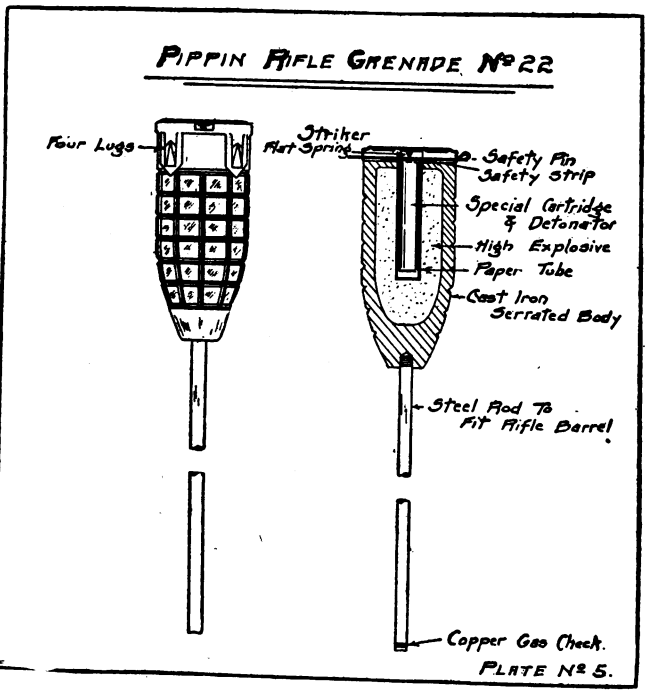

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3. Replace the steel cap.

Note.—The safety pin must not be removed during the above operations.

To Fire.—1. Lower the rod into the barrel of the rifle.

2. Feed the rifle with special cartridge.

3. Immediately before firing, withdraw the safety pin.

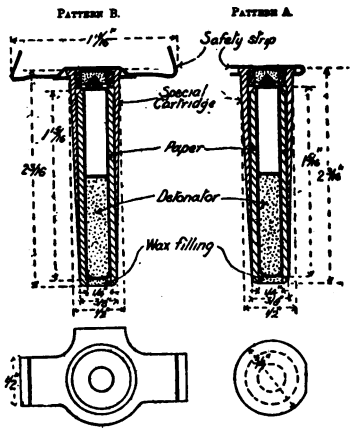
Special Precautions.—1. The safety pin must not be removed before the grenade has been inserted in the rifle.

2. A ball cartridge should not be used, as this may burst the barrel.

3. Only the special detonator holders and cartridges provided must be used.

4. The rod should be oiled, but only slightly, before placing it in barrel of rifle.

5. Owing to the grenade being aimed as soon as the safety pin has been removed, it is advisable to fire it from behind cover.



For No. 22 (Pippin Rifle Grenade).

DETONATORS. NO. 22 PIPPIN GRENADE

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GRENADE, HAND, NO. 1, OR SERVICE GRENADE (PERCUSSION).

Weight complete, 2 lbs. (See Plate No. 7.)

Description:

The grenade consists of a brass cylinder encircled by a narrow cast iron ring serrated to break up into sixteen fragments.

The cylinder is mounted on a wood block to which a cane handle 5 inches long is attached. Four streamers are nailed to this end of the body. Total length of grenade 12½ inches.

The brass cylinder or body of the grenade is filled with explosive and has its upper end closed by the detonator holder, fixed by three screws. This holder carries two pins for securing the detonator. The body has two knobs and two indicating stops fitted above the serrated ring.

The firing needle is carried in the removable cap, which has two grooves formed on it in which slide the knobs on the body. The cap is centrally pierced for the safety pin.

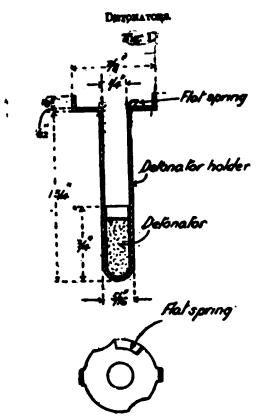

Fig. No. 1 (Service Hand Grenade).

DETONATOR FOR NO. 1 HAND GRENADE

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SERVICE HAND GRENADE No 1.

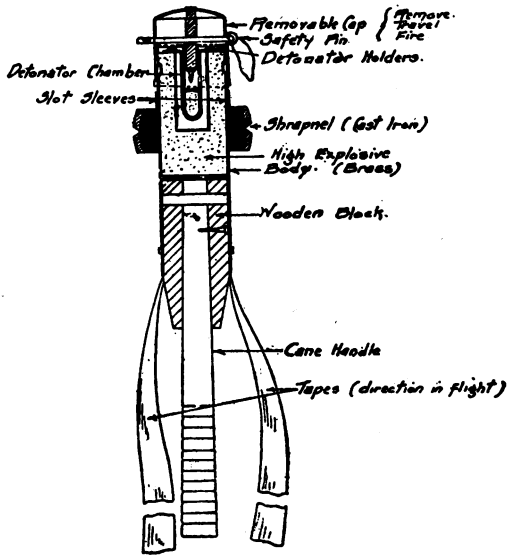

PLATE No 7.

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"Remove," "Travel" and "Fire" are marked on the outer surface of the cap. When the knobs on the body are opposite the word "Remove" the cap can be pulled off.

When opposite "Travel" cap cannot be moved.

When opposite "Fire" the cap can be pushed down so that the firing needle can pierce the detonator.

When the grenade is thrown, owing to its weighted head and streamer on handle, it will fall on its head and the five-ring needle will be forced into the detonator.

Instructions: To Prepare for Use.—1. Remove the cap (leaving the safety pin in) and insert detonator by pushing it home and turning it to the left. Special detonators are provided with the grenades.

2. Replace the cap and turn to "Travel."

To Fire.—1. Turn to fire.

2. Immediately before throwing, pull out the leather strip from the safety pin and free the becket.

3. Hold the grenade in the right hand, pull the safety pin with the left and throw.

VANELESS RIFLE GRENADE, NO. 20, MARK I.

Weight complete, 1 lb. 6 ozs. (See Plate No. 4.)
Mean maximum range, 250 yards.

Description:

This grenade is an improved form of No. 3 without the wind vane and spring clip. The safety pin is below the releasing collar.

Body.—Serrated steel filled with explosive. Down the center of the explosive is a brass tube, into the forward end of which the detonator is inserted. The body is closed by the base piece. This carries the striker pellet, two retaining bolts, releasing socket and safety pin. To the base piece is fixed a 10-inch steel rod.

Detonator Holder.—Consists of a special brass tube which screws into the head of the grenade. It contains a detonator and detonator cap. Until the detonator holder is inserted the head of the grenade is closed by an ebonite screw plug.

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VANELESS RIFLE GRENADE Nº 20

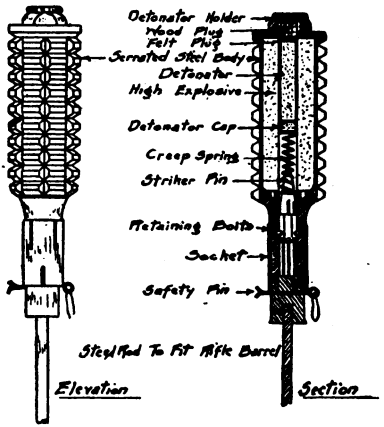

PLATE Nº 4

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Cartridge.—A special blank cartridge is supplied to fire the grenade.

Action.—On the shock of the discharge, the releasing socket sets back, the retaining bolts are no longer held in position by its inner surface and fall out. On impact the striker pellet sets forward against the creep spring on to the detonator cap, thus firing the grenade.

Instructions: To Prepare for Use.—1. Holding the grenade head downwards, remove the ebonite screw plug and tap the grenade on the hand, so as to make certain that the striker is not free.

2. If correct, screw the detonator holder.

To Fire.—1. Lower the rod into the barrel of the rifle.

2. Load the rifle with the special cartridge.

3. Immediately before firing, withdraw the safety pin.

If the grenade is not fired, the safety pin may be replaced.

Special Precautions.—1. Grenade should be tapped on the palm of the hand before inserting the detonator holder, to insure that the striker pillet is properly held in place by the retaining bolts.

2. Releasing socket must not be tampered with.

3. After withdrawing the safety pin, it should be noticed that the releasing socket is still in its right position. It may slip back (thus releasing the retaining bolts) if it has not been properly secured over the retaining rim during manufacture. A grenade in this condition is dangerous and may explode prematurely at the muzzle.

4. The safety pin must not be withdrawn before the grenade has been inserted in the rifle.

5. The grenade must not be fired with a cartridge with bullet, as this may cause the barrel to burst.

6. The rod should be only slightly oiled before being placed in the muzzle.

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GRENADE NO. 2, OR TONITE OR MEXICAN GRENADE (PERCUSSION).

Weight complete, 1 lb. (See Plate No. 3.)

Description:

This grenade consists of:

Handle.—Cane 7 inches long, with tape to assist grenade to fall on its head. A small steel rod about 2 inches long is fixed to the other end of the handle by means of a brass collar riveted to the cane. The end of the steel rod screws into the body of the grenade.

Body.—Consists of a brass cylinder, 4¾ inches by 1¼ inches diameter.

A band of ribbed cast iron is fixed on the end near the head. This band is man-killing shrapnel and helps to weight the head of the grenade.

There is a small tube passing down the center of the large cylinder, and the intervening space is filled with explosive (Tonite). This tube contains the spring, striker and detonator (when loaded).

The striker consists of a brass rod 1½ inches long with a conical head and steel needle point. A brass spiral creep spring 1¼ inches long is fixed round a groove in the head of the striker. This spring is sufficiently strong to prevent the needle reaching the detonator without a fairly strong blow.

The striker is held in position by a safety pin passing through the body of the grenade and the end of the striker.

Detonator.—Consists of a brass tube, which can be screwed into the head of the grenade. The bottom of the detonator tube is closed by a thin brass plate. During transport, the detonators are carried separate from the grenade, and a wooden plug is screwed in in place of the detonator to keep out damp and dirt.

Instructions: To Prepare for Use.—1. Untie the tape and handle.

2. Unscrew the wooden plug and insert the detonator. The grenade should be held head downwards when doing this, in order to make certain that the needle is secure.

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Hales Grenade (Tonite or Mexican)— No 2. (Percussion).

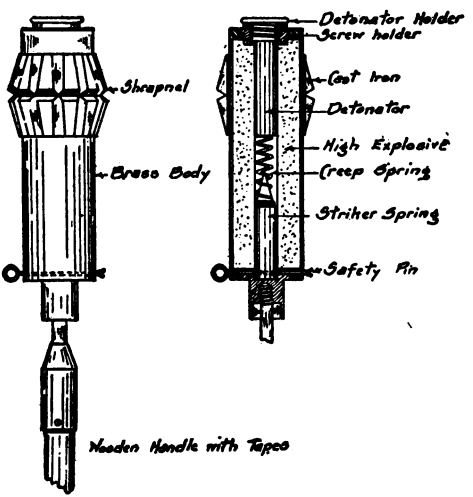

Plate No 3.

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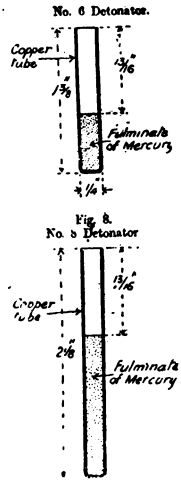
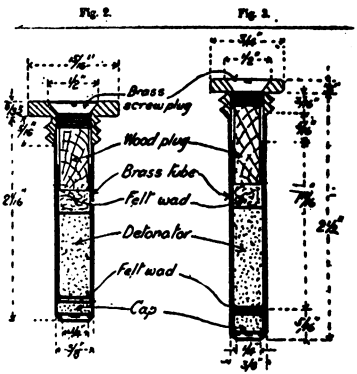
To Throw.—1. Hold the grenade in the right hand.

2. Pull out the safety pin with the left hand.

3. Throw the grenade.

Action.—When the grenade leaves the hand, the weighted head and tape streamers cause it to fall on its head. On reaching the ground, the body of the grenade is stopped by the impact, and, the striker being free, flies forward, compressing the spring sufficiently for the needle to pierce the detonator and thus explode the grenade.





For No. 2 (Hales or Mexican Hand Grenade).

For No. 3 and No. 30 (Hales Rifle Grenade and Wireless Pattern).

DETONATORS FOR HALES OR MEXICAN HAND AND RIFLE GRENADES

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"P" GRENADE, WEIGHT COMPLETE, 1 POUND 1 OUNCE.

Description.

The bomb consists of a tin cylinder 3 inches in diameter and 5 inches long. In one end is soldered a detonator tube and a short length of copper wire for binding purposes. The cylinder is filled with red phosphorus.

The bomb, when exploded, produces a thick white smoke. The phosphorus thrown out causes burns, and may cause fires.

The detonator supplied is the ordinary No. 8, fitted with a 9 seconds' fuse and Brock lighter.

To Prepare for Use.—Insert the detonator in the detonator tube and bind in place with the copper wire.

To Fire.—Tear off the tape from Brock lighter and rub block blob of composition, so exposed with the brassard supplied.

Precautions.—Wherever stored, the grenades should be examined from time to time to see that the tin has not become corroded or rusted through into holes, as there is a danger of fire when the phosphorus is exposed to the atmosphere.

THE JAM POT BOMB.

During the first part of the war, as sufficient time had to be allowed for the manufacture of grenades by the Allies, the "Jam Pot" was greatly used and was manufactured by the troops in "billets" behind the line in the following way:

Old tin cans, jam tins, tomato tins and other tin containers were collected.

The tin can was then slitted or cut at intervals from the top edge down to a distance of approximately two inches. In the center of the can was placed the regulation cone of gun cotton with a hole in the center. Around this cone were packed broken pieces of iron and steel, bolts, nuts, etc.—in fact anything which could be used as shrapnel. A detonator and fuse were then placed in the

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gun cotton and projecting above the top of the can. The cut portions of the tin were then turned or bent down against the shrapnel, thus holding it in and completing the bomb.

Usually, as a precaution to prevent fuse and detonator from falling out, these were fastened or tied in with wire or string.

This "home-made" bomb, when in action, was lighted and thrown by hand or catapult and proved quite effective.

THE HAIR BRUSH.

The racket bomb, usually referred to as the "Hair Brush" on account of its appearance, was also manufactured by the troops and used in the attack to demoralize the enemy, as the noise created by its explosion was very great.

This bomb was constructed as follows:

A board about 12 inches long and 6 inches wide was cut down to the shape of a brush. On the big end of this was wired or tied a slab of wet gun cotton (to make greater noise). In the center of the slab was placed the dry primer or cone of gun cotton with detonator and time fuse. This, when lighted and thrown, made an explosion like a high explosive shell and helped greatly in causing panic among the enemy, especially when thrown into the trench, besides injuring those in the vicinity.

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BOMBERS IN THE OCCUPATION OF CRATERS.

A most necessary part of the work to be done by bombers is the occupation and defense of craters, which may be blown up for tactical or stragetic reasons by either the enemy or ourselves.

Craters may be formed as a result of one of the following mining operations:

1. An attack by the enemy on our trenches.
2. An attack by us on the enemy trenches.
3. For underground fighting.

The possession of a crater may offer the following advantages:

1. It can be consolidated and turned into a "strong point," which, when garrisoned by a small or large number, depending on its size, may act as a veritable fort.
2. It will usually be found to give command of the ground in that vicinity.
3. It will form an obstacle of the strongest kind against enemy advances.

When craters are exploded by us, to be used in conjunction with an attack by us on the enemy line, our object will be to immediately seize and hold these craters, and, if possible, a position in front, as the craters can then be more readily turned into "strong points."

When craters are blown up by the enemy in their attack on us, we should immediately rush forward parties of bayonet men and bombers, and, if possible, automatic guns, in an attempt to gain the near side or lip of the craters formed, using this lip, or wall of earth, as a breastwork. From this position, by the constant use of grenades and rifle fire, attempt to prevent occupation by the enemy and "hold up" their attack.

After being taken, this near side of the crater is turned into a fire trench, with "parapet" and parodos, and later, when possible, communication trenches are run back and connected up to the front line in rear.

When about to blow up craters, provision must be made beforehand for sufficient parties of bombers for each point blown, these parties to take forward a good supply of

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grenades, as they may be "cut off" from communication with the main body for some time.

The hollow or center of the crater should be used for the placing of obstacles. A good form of obstacle to use here is the "knife rest." These can be brought up and simply thrown or rolled in, thus forming a good obstacle against enemy advance.

Bombing stores or depots should be arranged for in the front line, with reserve carriers as close to the point of action as possible.

It must not be thought that troops are always to occupy the near lip of an enemy crater, as this is only done when the enemy occupy the farther slope.

When possible, a bombing and concerted attack should be made to occupy the enemy side of all craters, as this position offers special advantages, as being closer and commanding a better view of enemy positions.

Where saps run back to the enemy line from these craters, a stretch of at least 40 yards should be filled in to prevent enemy bombers from being within bomb throwing distance.

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BOMBING ATTACKS

NOTES OF SOME RECENT BOMBING OPERATIONS, WITH EXAMPLES.

1. Co-operation:

(1) Bombing attacks carried out without careful organization and co-operation of Lewis' guns, rifle grenades, Stokes' mortars and snipers are likely to fail, as a rule, and the most careful training at brigade and divisional bombing schools is necessary in order to insure the best results.

(2) Snipers and Lewis' guns must be handled boldly. Pushed out in the open to a flank, they are likely to be of the greatest value in repelling counter attacks and assisting the advance of bombing parties.

(3) Lewis' guns were often most valuable as substitutes for bombing squads for blocking straight pieces of trench.

The Germans frequently make us of machine guns for this purpose.

2. Stokes' Mortar Shells:

(1) It has been found useful to provide bombers with Stokes' mortar shells, with one safety pin and creep spring removed, thus turning the shell into a Mills' grenade on a large scale, with a priming fuse up to 13 seconds. One of these shells is quite sufficient to severely damage entrances to dug-outs, tunnels, etc.

3. Mills' Rifle Grenades.—These rifle grenades have been found especially useful in assisting the advance of bombers, their range of 100 yards being of great value when the bombers are out-ranged by German "Egg" grenades.

An ample supply of rifle grenades is of the utmost importance, for they can frequently prevent hostile bombing parties from being organized for attack.

In order to facilitate the supply of Mills' rifle grenades, all Mills' grenades are now being tapped for rods.

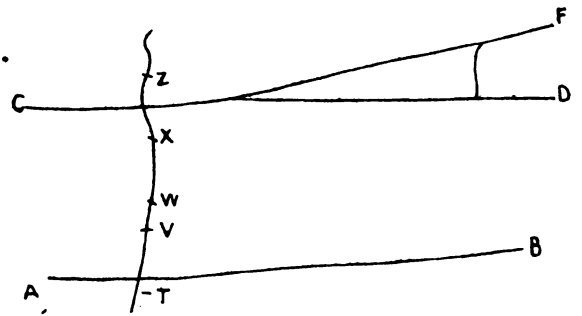
4. Supply of Grenades.—The proper organization of a plentiful supply of bombs is absolutely essential. Several advanced dumps, therefore, must be made when bombing operations are anticipated. The expenditure of bombs is extraordinarily large, and the replenishment of the advanced dumps is, therefore, a matter of great difficulty. A permanent carrying party is essential; troops in support, if recently relieved, are often too exhausted to perform this very arduous duty.

The use of a chain of men for passing grenades forward in sacks from hand to hand proved very successful. When this method could not be used, relays working within well-defined limits, that is, from dump to dump, also proved very satisfactory. In this case grenades were carried in boxes from brigade headquarters to the fire-trench dumps and thence in sand bags, 12 in each bag.

EXAMPLE I.
ATTACK BY THE — BATTALION (AT NIGHT).

1. Orders.—The line C, D, C, F was the objective for a company holding the line A, B.

We had a block at V, the enemy having blocks at W and X in the same trench.



CUT "X"

One section of the regimental bombing platoon was ordered to work along the trench to the objective and to establish a block on the other side of it. A second section

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was ordered to follow in close support, and a Stokes' mortar at T was ordered to co-operate. Company bombing sections were to follow the second wave of their company to deal with enemy dug-outs and to clear up generally.

2. **Narrative.**—The first bombing section moved up to block V, and the second wave, moving out into No Man's Land, commenced bombing along the trench.

They passed the first enemy block (W) and were halfway to the second (X) when the assault was delivered by the first wave. From then to the first objective, very little opposition was encountered.

On arriving at the intersection of trench V, W. X with trench C, D, they were assailed with bombs on their right and left from this latter trench, and also from Z, where enemy had established another block.

The trench mortar, being quickly informed, opened fire on Z.

The second bombing section was ordered to deal with the enemy's bombers on the right and left, while the first bombing section continued the advance under cover of the trench mortar, which increased its range about 15 yards every three shots.

Z was passed and a block established about 20 yards on the other side of it.

3. **Remarks.**—The total casualties of the two bombing sections were six wounded, while ten of the enemy were found dead in the trench V, W, X, Z.

The system of replacing casualties worked satisfactorily.

The bombers had no difficulty in following up the trench mortar fire.

EXAMPLE II.
ATTACK BY — BATTALION.

1. This battalion, in conjunction with — Bn. Wilts' regiment, carried out a successful attack on the Hindenburg trench. The right company was given special instructions to guard its right flank.

2. The objective was reached without much difficulty. Two squads of bombers, each consisting of ten men, in-

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cluding two Mills' rifle bombers, were then ordered to hold point X, and, if possible, push on to Y, supported by a Lewis gun.

At point X, a party of six enemy bombers was encountered and driven back by two bombers after an encounter of a few seconds. Two bays behind them, a party of twelve to fifteen bombers was discovered; it stood its ground. It was evidently covering a machine gun team, which was seen to be trying to mount a machine gun. This opposition was dealt with as follows:

(a) Riflemen were at once thrown out on either flank in shell holes, well out of bombing range.
(b) A Lewis gun was brought into action on top of a high traverse, enfilading the whole enemy trench, and immediately putting the enemy's machine gun out of action.
(c) A bombing squad attacked the enemy as follows: One officer with periscope (who also threw bombs); three bombers, each carrying 16 bombs, and a man with an artillery flag.
(d) A Stokes' mortar fired on point Y throughout the operation.

After about fifteen minutes' fighting, the entire trench was captured and 23 prisoners taken. We suffered no casualties from the enemy's bombs.

3. The success of the operation was due to the following facts:

(a) The promptitude with which the Lewis gun and snipers got into position, thereby preventing the enemy from throwing his bombs to the best advantage, while our men outthrew him throughout.
(b) The composition of the bombing team prevented crowding, thereby obviating casualties and indiscriminate throwing.

The use of the periscope rendered the employment of bayonet men unnecessary, and made it possible to observe each bomber's individual aim.

The artillery flag, though disclosing our position, was most necessary as a guide to the sniper, Lewis gun and trench mortar battery.

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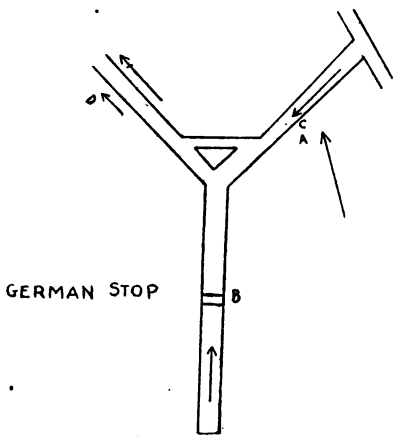
(c) A few smoke bombs were carried, and two of the four dug-outs found had to be burned out, as Germans were found coming out of them, after the bombing party had passed, and showed fight.
(d) The Stokes' gun kept up an accurate fire on point Y, and thereby probably prevented the retirement of the Germans who were captured.

No Mills' rifle grenades were used, as our men successfully outthrew the enemy with hand grenades.

EXAMPLE III.
ATTACK BY — BATTALION.

The battalion made a successful attack on a German strong point and bombed up the trench to the north of it.

The attack was made about midnight; during the day our artillery and Stokes' mortars had shelled the strong point. This was "V" shaped. (See Sketch Q.)



SKETCH "Q"

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Two platoons were directed to attack across the open ("A" on sketch), and bombing parties to bomb up the trench on either side ("B" and "C" on sketch), and to join up with them.

Immediately before the assault, the strong point was bombarded for a few minutes with rifle grenades. The enterprise was carefully timed, and each party reached its objective simultaneously and soon joined hands.

A considerable number of Germans were found in the deep dug-outs and taken prisoners. Others ran up the trench ("D" on sketch), followed by our bombers, who killed several and took more prisoners. But finding they had rushed beyond their objective, and that the enemy were rallying and trying to surround them, they retired to the bomb stop which was being made at the pre-arranged objective. As but little opposition was at first met with, the bombing parties pushed on very quickly.

Branching off to the right and left were a large number of deep dug-outs and trenches, and, after finding "stops" over each dug-out, bombing teams for each branch trench and working parties to make barricades, few men were left when the final objective was reached, where the most resistance was experienced. It was found more satisfactory to attack by daylight than by night, owing to the difficulty of seeing where the various dug-outs and branch trenches led to.

THE OCCUPATION OF CRATERS.

The occupation, consolidation and holding of craters should be thoroughly understood by all officers, at least in a general way, but should be understood especially well by two or three officers in every battalion.

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Mines are sometimes laid and exploded by us to form craters, which are to be promptly occupied and placed in a state of defense, utilizing the lip of the crater for this purpose.

Craters are usually formed to cover one of the following operations:

An attack either by us on enemy trenches, or an attack by the enemy on our trenches.

For underground fighting.

Craters can be usually turned into strong points or redoubts, capable of being garrisoned by a small number, and has the advantages of a commanding view of the ground in the vicinity, and forms a considerable obstacle against any advance of the enemy.

A series of mines are sometimes exploded to our front and immediately occupied. Later, these craters thus formed are connected up by trenches between each point, thus forming a new and advanced line of trenches.

Before mines are exploded, sufficient study of the expected result of these explosions should be made, so that the fullest preparation could be made beforehand to preclude any possibility of the non-success in the occupation of these craters. For this reason it is always best, if possible, to have this work done by mining engineers of the R. E. corps, who are thoroughly acquainted with the effect and strength of explosives used in certain ground.

Before mines are exploded, provision must be made for working parties, carrying parties, with material, and parties of infantry for occupation. These must be held in readiness to immediately dash forward the moment the explosion takes place.

The common practice is to construct fire trenches along the top or lip of the crater, which is formed by the earth thrown up by the explosion. Dug-outs and shelters are usually constructed under the inner slope of these craters. Communication trenches should lead from these fire trenches to the inside of the crater. To make these craters more difficult to capture, barbed wire entanglements, knife rests, etc., should be freely used, and can be easily thrown out to the front.

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DRESS AND EQUIPMENT WORK IN THE ATTACK.

The following applies to all infantry units, and is the dress and equipment which are worn during an attack:

Dress.—Uniform and clothes on issue.

Rifle.—Rifle as issued.

Ammunition.—170 rounds per man, except for men employed as bombers, signalers, M. G. crew, etc. These men will carry 50 rounds only.

No. 5 Mills' Grenades.—Each man will carry two, one in each top pocket of coat or serge.

Aeroplane Flares.—Each man will carry two, one in each side pocket, with exceptions as above, who will not carry these.

Rations.—One iron ration in haversack; one tin of solidified alcohol in mess tin.

One water bottle, filled.

The surplus clothing will be left back in the trenches from which the attack is made, or in the event of troops taking part and not occupying trenches, these clothes will be left in the transport lines under the care of the quartermaster.

Wire cutters carried forward by the two leading waves in sufficient numbers and by reserve companies.

Wire cutters are attached to man's shoulder strap in each case, when the ordinary type of wire cutters are used.

One entrenching tool (pick and shovel combination).

Web equipment, with haversack worn on back.

Box respirator or helmet.

Articles in haversack, i. e., cardigan jacket, towel and soap, spare oil tin, iron ration, waterproof sheets; this is rolled under the haversack. In cold weather the great-coat is taken forward instead of the rubber sheets.

Every man of consolidating companies and about 50 per cent. of reserve companies carry either a pick or a shovel. Twelve S. O. S. rockets are carried to each company. The P. grenades are carried by mopping up parties. Hand and rifle grenades are carried by bombers in special haversacks or canvas buckets. Fifteen grenades to each man, and every man five rods and five blank cartridges for rifle grenades.

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DESCRIPTION OF GERMAN GRENADES AND INSTRUCTIONS FOR THEIR USE.

(i.) German hand grenades which have been found are of two types: those which have the appearance of service articles and those which are obviously improvised. With the latter, great care is invariably taken to protect the charge from dampness, and to render it flashproof by waxing, etc.

Grenades are ignited either by time or percussion. With the former, the time of burning is about six seconds, and the fuse is ignited by one of the following methods:

(a) Spring striker and cap.

(b) Friction tube.

(c) Match-head lighter.

Attached to fuse and detonator.

(ii.) The following precautions should be taken with any grenades that may be found or captured:

1. The grenades should be examined at once by a grenadier, in order to find out whether they are live, how they are fired, etc.

2. The means of firing will probably be immediately apparent to a trained grenadier, but during examination, grenades should be handled with care.

3. No man who does not understand grenades should touch them, but should report the presence of a store of grenades to the nearest grenadier, N. C. O., or officer.

4. If being used against the enemy, a grenade should be thrown as soon as it is "lit," even if there is no apparent evidence of the fuse burning.

5. Arrangements for removing, storing or destroying grenades found in a captured position should be made as soon as possible by grenadier officers.

6. Grenadier officers will also be responsible that when samples of grenades are taken back to headquarters for examination, the grenades are not in a dangerous condition, and have the detonators removed.

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SPHERICAL GRENADE.

(iii.), Weight, 1 lb. 10 ozs. Can be thrown about 30 yards.

Description.—(See Plate 13, Figs. 1 and 2.)

The body is spherical, about 3 inches in diameter, made of cast iron about 1/3 inch thick, and is filled with black powder or other explosive which does not require a detonator. The body is coated with varnish inside and out.

Fig. 1.

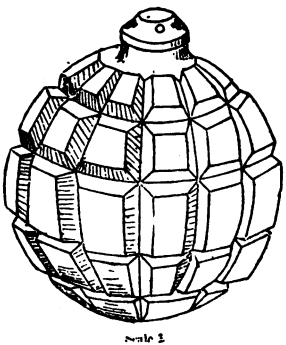
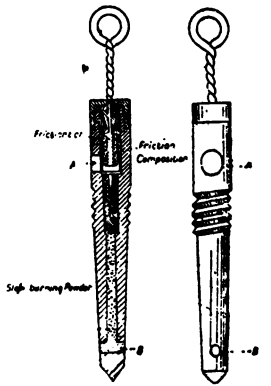


Fig. 2.



Section Elevation.

PLATE NO. 13

Method of Ignition.—Combination of friction tube, lighter and fuse. The friction tube is fired by pulling out the wire in the direction of the axis of the tube. A wrist strap, with a swivel hook, is usually provided for this purpose. Time of burning, 7 seconds. A similar lighter which burns for 5 seconds is also provided. It is distinguishable by the head of the fuse being painted red.

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Safety Arrangements.—1. Grenade and fuse kept separate during carriage.

2. The vent for the fuse in the grenade is closed by means of a zinc plug.

3. The bolts, A and B (see Fig. 2), in the lighter are covered with waterproof paper.

4. The wire is bent in order to avoid a direct pull.

Instructions: To Prepare for Use.—1. Take the lighter, remove the oiled paper from A and B and straighten the wire, taking care not to pull it.

2. Insert the lighter.

3. Put on the wrist strap.

4. Hold the grenade in the right hand, with the igniter towards the wrist.

5. Hook the swivel at the end of the strap on to the wire pull of the grenade.

6. Throw the grenade.

Note.—If a strap is not provided, a nail, or a loop of string, should be passed through the wire pull.

GRENADE WITH SPRING IGNITER CHARGED WITH MISSILES, ETC.

Weight, 2½ lbs.

Description.—(See Plate 14, Figs. 1 and 2.)

The body consists of a cylindrical tin of explosive, 2 inches diameter, placed in a tin 3 inches diameter, the space between being filled with nails, scrap-iron, etc. The bottom is closed by a wooden plug in which a small hole is bored for the detonator.

The handle is of wood, 8¾ inches long, the head of which forms the wooden base plug. To secure the body to the handle, the edge of the outer cylinder of the body is turned down over the base plug.

Method of Ignition.—Consists of a spring, striker and cap, encased in brass tubes, fastened to the handle by a steel band. Fuse and detonator are attached in the usual way.

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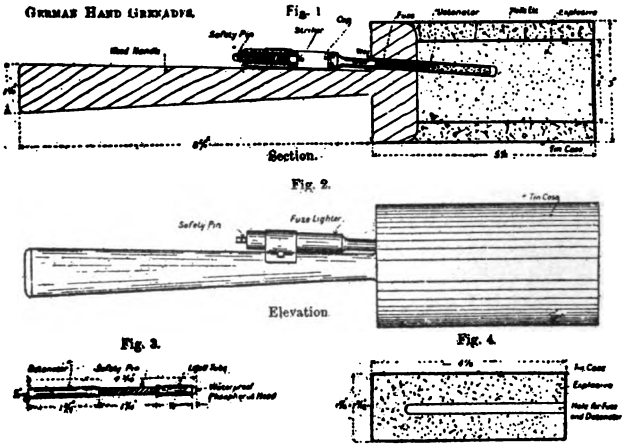

PLATE NO. 14

The spring is compressed by a collar at the end of the striker rod. The rod is held back by a safety pin passing through it at the end of the case. As soon as the pin is released, the striker flies forward and fires the cap, thus lighting the fuse.

Fuse about 2 inches long. Time of burning, 6 seconds.

Instructions: (a) To Prepare for Use.—1. Hold the grenade in the right hand.

2. Withdraw the safety pin.

3. Throw at once.

(b) To Render Useless.—1. Remove the handle and base plug by raising the turned-down edge of the cylinder. This must be done very carefully.

2. Empty the contents of the body.

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SMALL TIN GRENADE.

(v.) Weight, 12 ozs.

Description.—(See Figs. 3 and 4.)

The body is a tin case 4⅞ inches by 1 11/16 by 1 11/16, filled with explosive.

Method of Ignition.—Combined match-head igniter, fuse and detonaor (see Fig. 3).

The match-head igniter consists of a small lead tube closed at one end with a ball of red phosphorus, varnished and covered with oiled paper.

A piece of safety fuse is pushed home and secured in position by crimping the tube round it; the detonator is fixed to the other end of the fuse in a similar manner.

Safety Arrangements.—1. The grenade and igniter are kept separate during carriage, and a wooden plug is put into the grenade in place of the detonator.

2. The phosphorus head is protected from friction and damp by waterproof paper.

Instructions: To Prepare for Use.—Take out the wooden plug—if necessary use the rectifier—and insert the igniter. (This is kept in place by the lead tube fitting tightly into its seating; the joint should be waxed.)

Tear off the paper cover from the lighter.

Hold the grenade in the right hand, rub the match-head with some rough material (side of match-box, etc.); a wind-match or pocket-lighter may be used instead.

Throw immediately.

Time of burning, 6 seconds.

To Render Useless.—Take out igniter and fill up hole with mud, etc.

CYLINDRICAL GRENADE WITH FRICTION TUBE. REGULATION TYPE.

Weight, 1 lb. 13 ozs.

Description.—(See Figs. 1 and 2.)

The body consists of a tin cylinder 4 inches by 2⅞ inches diameter, which contains a cartridge of explosive

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This is closed at the top with a lid held in place by four clips; at the bottom there is a screw-threaded hole to take the handle. The bottom of the cartridge is fitted with a paper tube for the detonator. On the side of the body there is a hook, by means of which the grenade can be attached to the belt.

The inscription on the body, "Vor Gebrauch Sprengkapsel Einsetzen," means "before use insert the detonator."

GERMAN HAND GRENADES.

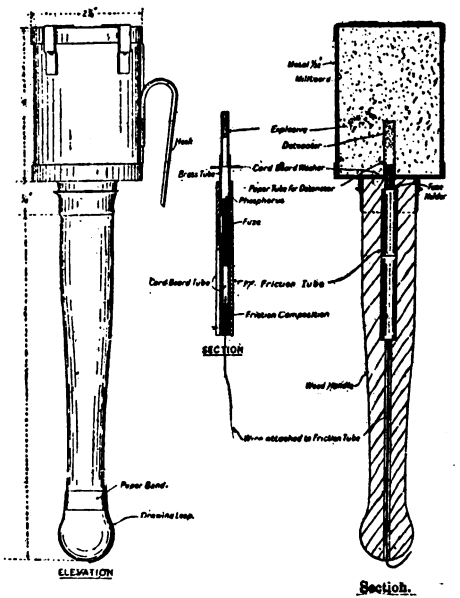

PLATE NO. 15

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Handle. Wooden, 9⅞ inches long, has a screw-threaded metal top which fits into the body. It is bored out axially to take the igniter and wire pull.

Method of Ignition.—Consists of a friction lighter and safety fuse contained in a cardboard tube. The igniter is actuated by pulling a string loop at the end of the handle. This loop is attached to the wire pull of the friction tube, and is fixed to the handle by means of a paper band. The mouth of the detonator fits into a brass tube at the top of the igniter, and is fired by the flash from a dab of phosphorus at the end of the safety fuse. Time of burning, 5½ or 7 seconds, as marked on the handle.

Safety Arrangements.—1. The grenade and detonator are kept separate during carriage.

2. The drawing loop is attached to the handle by a paper band, which must only be removed before firing.

Instructions: To Prepare for Use.—1. Unscrew the handle and see if the detonator is in position; if it is, refix the handle.

2. Hold the grenade in the right hand.
3. Tear off the paper band with left hand.
4. Pull loop with left hand.
5. Throw immediately.

If the detonator is not in position, search should be made for a supply of the proper detonators. Fit the mouth of the detonator into the projecting brass tube, screw in the handle and then proceed as in 2, 3, 4 and 5 above.

To Render Useless.—1. Unscrew handle, remove detonator.

2. Pull drawing loop and throw handle away.

HAIRBRUSH GRENADE WITH SPRING IGNITER.

Weight, 2½ lbs.

Description.—(See Page 85.)

The body consists of a tin box 2¾ inches by 2¾ inches by 6 inches, filled with explosive. This box is nailed on to a wooden handle. Length complete is 15 inches.

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Method of Ignition.—Spring igniter, fuse and detonator, similar to that used in the cylindrical grenade, with spring igniter.

The igniter is kept in position by means of a zinc band screwed on to the handle.

Safety Arrangements and Instructions.—As for cylindrical grenade with spring igniter (see paragraph vi.), except that the safest way to destroy this grenade is to fire it in a pit or disused trench.

DISC HAND GRENADE (PERCUSSION).

Weight, about 1 lb.

Description.—(See Page 85, Figs. 2 and 3.)

The body consists of the two iron shells convex on the outside and with the edges either turned over or riveted. It contains two circular bags of explosive, each containing 2 ozs.

Method of Ignition.—Consists of six metal tubes in the shape of a star, meeting at the center of the grenade plug. Four of these tubes carry striker pellets and caps, and opposite to each cap is one of the four points of a cross. The outer end of each of these tubes is closed by a screwed plug. One of the remaining two tubes carries the detonator, of which the inner end is open. This tube is closed by a screwed plug with milled head with the letter "S" on it.

Safety Arrangements.—The sixth tube contains a safety pellet divided into two prongs, one of which passes on each side of the cross and protects the points. This pellet is retained in its position by a cap which closes the outer end of this tube. This cap is secured to the tube either by clips, or by a safety pin with ring.

Instructions: (a) To Prepare for Use.—1. Hold the grenade in the right hand, safety pin upwards.

2. Pull out the safety pin with the left hand.

3. Pull off the cap and hold the safety pellet in position with the right forefinger (if necessary, the safety pin can be replaced).

4. Throw the grenade as high as possible, taking care that the edge is vertical.

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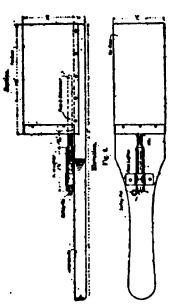


German Grenades.

Fig. 2.

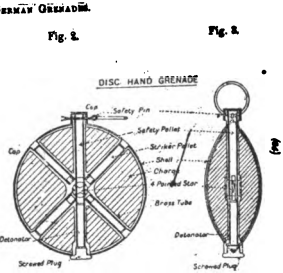
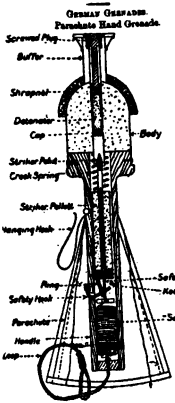
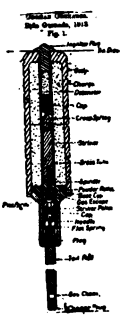


Fig. 3.





GERMAN GRENADES

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Note.—These grenades can also be thrown with the strap provided in each box, but this requires considerable practice.

(b) To Render Useless.—1. Unscrew the plug of the tube, marked "S," opposite to the safety pin.

2. Remove detonator.

Action During Flight.—Owing to the grenade turning over, the safety pellet flies out and the grenade becomes sensitive. When the edge of the grenade strikes the target, the corresponding striker pellet drives the cap forward on to the point of the cross. The flash passes into the detonator and explodes the charge. A low or horizontal throw may cause a failure. On detonation, the fragments fly out laterally, and not to the front or rear.

PARACHUTE GRENADE (PERCUSSION).

(ix.) Description.—(See Page 85.)

The body, which is painted black, consists of a tin cylinder of explosive with hemispherical head of larger diameter containing shrapnel bullets. A buffer cylinder passes through the body and projects, so as to produce the explosion slightly above ground. The base of the body is closed by a wooden plug at the handle. A parachute safety arrangement is attached to the head of the handle in order to prevent fragments flying to the rear on explosion, and also to cause the grenade to fall on its head.

Method of Ignition.—Consists of: 1. The detonator in the buffer cylinder supported by the screwed plug at the end.

2. The percussion pellet with point and spiral spring.

Safety Arrangements.—Consist of the following: 1. A cord 7 metres long which normally is coiled up inside the handle, is attached to a long needle passing down the percussion pellet. A safety hook retains a ring attached to the end of the percussion pellet and the needle passes through a hole in this hook. After the first 7 metres of the flight, the jerk on the cord pulls out the needle, and the safety hook is thus free to fall out sideways and so allow the percussion pellet to move forward on concussion.

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2. Keep pin and creep spring. The former prevents the percussion pellet from falling back.

Instructions: (a) To Prepare for Use.—1. Unscrew the plug in the head.
2. Place in the detonator, fulminate downwards.
3. Screw in the plug.
4. Tear off the band holding the parachute.
5. Holding the loop of the cord firmly with the first and second fingers of the right hand, take out the plug from the handle, unwinding as short a length as possible of the cord.
6. Hold the grenade in the right hand.
7. Retaining the loop of the cord, throw the grenade so that it will reach a height of 12 or 13 feet.

(b) To Render Useless.—Remove the detonator.

Note.—The grenades may be found "live," in which case 1, 2 and 3 have already been done.

This grenade can be used in attack or defense. but it is particularly designed for the former, as the fragments are projected in a forward direction only, and so are not dangerous to the throwers. The safety arrangements prevent the grenade from becoming dangerous, until it has flown about 7 metres.

RIFLE GRENADE, 1913 (PERCUSSION).

(x.) Weight, about 2 lbs. complete. Charge, 3.2 oz. explosive.

Description.—See Page 85.)

The body of steel (12 cm. long and 4 mm. thick) is serrated longitudinally and transversely, so that on detonation it may split up into fragments of sufficient size. It is painted grey. The base is closed by a brass base cup, which has screwed into it a steel tail rod 18 inches long, with copper gas check to take the grooves of the rifling. The rod has a thin coating of copper to protect it from rust, and also to protect the barrel. A tin disc is fastened to the head of grenade by igniter plug for short ranges.

Method of Ignition.—Consists of an igniter plug, carrying cap and detonator, which is screwed into the head of

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the grenade. A brass tube passing through the center of the grenade contains a striker pellet, with needle and creep spring.

Safety Arrangements.—1. Powder safety arrangements contained in base cup. Screwed into the striker pellet is a spindle, which passes through into the base cup, and has at its lower end a small platform with three flash-holes. On this rests a pellet of compressed powder, the object of which is to keep the striker from moving forward until a short time after the grenade has left the rifle. This powder is ignited by means of a small brass pellet with a cap, which sets back on the shock of discharge, and, flattening a small spring, is penetrated by a needle on the screw plug, closing the base cup. A vent hole in the base cup allows the escape of the gases of combustion. This is normally sealed with wax.

2. The powder, having burnt away, the striker is only prevented from moving forward by a creep spring, the resistance of which is overcome on concussion.

Instructions: (a) To Use.—1. Screw in the igniter plug (with tin disc for ranges under 200 yards).

2. Lower the grenade carefully into the barrel.
3. Insert a rifle grenade cartridge in the breach.
4. Fix the rifle at the required elevation.
5. Fire the rifle.

(b) To Render Useless.—Unscrew the igniter plug in the head of the grenade.

Precautions.—1. A German rifle only can be used.

2. Care must be taken that the grenade is not dropped, especially if falling on the tail rod, as then it is liable to become "live," and will therefore detonate on firing.

3. The special rifle grenade cartridge should be used, and in no case a ball cartridge.

4. Tail rods which jamp or rub when being placed in the barrel must not be used, and no force is to be employed.

5. Damp tail rods should be dried before use. All rods should be firmly screwed in.

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RIFLE GRENADE, 1914 (PERCUSSION).

Weight, about 2 lbs.

Description.—See Plate 18, Figs. 1 and 2.)

The body is of cast iron, 5 mm. thick, and contains the charge (2¾ ozs.) made up in a thin cardboard cylinder, which is retained in the grenade by a shoulder piece screwing on to the body. The nose of the grenade is screw threaded to take the percussion fuse, and the base to take a nipple for a tin disc and tail rod with gas check. Up to the time of fusing, it is protected from dust and damp by a plug and leather washer. The body, which is painted field grey, is serrated to give fragments of sufficient size on detonation.

Method of Ignition.—The percussion fuse contains an exploding charge with detonator and cap. The last named is set off by a striker pellet, the needle of which lies flat on top of the cap when in the safety position. The striker and spring are contained in a percussion pellet screwed into the socket of the fuse.

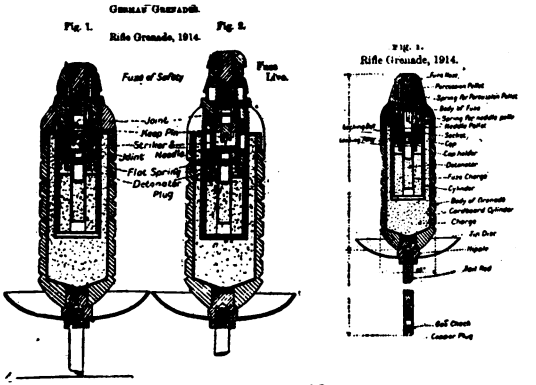

PLATE NO. 18

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Safety Arrangements.—1. The percussion pellet is retained in position by a locking ball which rests in a groove in the socket and percussion pellet. This ball cannot fall out owing to a locking ring which is held up by a flat spring with curved ends. On the rifle being fired, the locking ring sets back, overcoming the spring, and the locking ball is driven out of its groove by the percussion pellet, which, acting under the pressure of its spring, moves forward together with the nose of the fuse out of the body. At the same time, the needle pellet, owing to its spring, pulls up the needle into the firing position.

2. The spring of the percussion pellet prevents any tendency to be driven back into the cap until striking the target.

Instructions: (a) **To Use.**—As for rifle grenade, 1913.

(b) **To Render Useless.**—Unscrew fuse from grenade.

Precautions.—As for rifle grenade, 1913.

The live grenade can be easily recognized, as the nose of the fuse will be either entirely or partially out of the body.

The live grenade is most sensitive.

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TRENCHES

DESCRIPTION OF AN AVERAGE SYSTEM OF TRENCHES.

Many things affect the laying out of a system of trenches, such as the location, the duration of time they are to be occupied, the number of troops who are available for working, and many other reasons dealt with in other portions of this book.

It is my intention, therefore, to outline an average system of trenches, working in as many trench features as possible, so that one will have a general idea of the system and arrangement throughout, as it is impossible to lay down a set system.

A front system of trenches comprises the firing line, or front line, in rear of which is the supervision trench; these are supported in rear by a support line and reserve trenches. The firing line is protected in front at an approximate distance of 20 yards by barbed wire entanglements and obstacles, with, generally, exits at fairly regular intervals. These exits being usually closed by obstacles called knife rests, which are wired to the entanglements on each side, and which are easily removable for the garrison when the occasion arrives. The bottom of the nearer portion of the entanglements must be under the fire of men occupying the parapet. The fire trench may be said to be composed of a series of compartments, divided by a series of earth abutments; in other words, the fire trench is traversed with traverses or abutments of earth at about every 18 or 30 feet. These traverses are for the purpose of protecting the fire bays or sections between each traverse from infilade fire and to localize the effect of shell bursts. These traverses are approxi-

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mately 9 to 12 feet long, and should overlap or be 2 feet wider than the fire trench itself. The sections between these traverses are the fire bays, or those portions of the front trench from which the men fire. Access from fire bay to fire bay is made around these traverses. In these fire bays, the walls or sides of the trench are held up by different forms of rivetting material. These bays are approximately 18 to 30 feet long and about 5 feet wide. In each of these fire bays are built fire steps, which should be 18 inches wide and high enough to allow of the men firing over the parapet, with rifles rested on the top or crest of the parapet, and should be of varying heights to accommodate men of all sizes.

The top portion of the trench should not be straight or regular, as when straight it gives the enemy a better chance to see any movement in the trench and makes observation easier for them. Machine gun emplacements, covered and exposed, are placed at suitable intervals, where their zone of fire will overlap and cover the frontage.

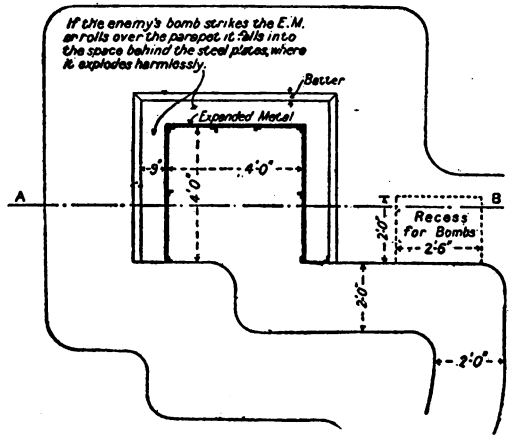
Behind the firing line, at a distance of 20 yards, is the supervision trench, access to the front line being by communication trenches, which should, if possible, run to every second bay of the firing line. This supervision line follows the general line of the firing line, but should be zig-zagged in such a way as to afford the fullest protection from infilade fire. In the forward or front face of a supervision trench are usually found the dug-outs, splinter-proof shelters, latrines, etc., with small arms jutting forward towards the fire trench for the purpose of bombing the enemy from the front line should it be penetrated. (See Sketch "F.")

Supervision trenches are to facilitate the movement of the troops, general supervision of same, and to afford more shelter, freer movement, and for accommodation of any additional men who are necessarily required when an assault is intended.

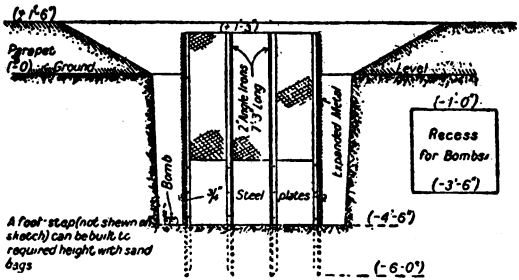
The support line, which is approximately 70 to 150 yards behind, is constructed as a second line of defense

BOMBING PIT.

Scale ½ in. = 1 ft.



PLAN.



SECTION ON A.B.

SKETCH "F"

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and to accommodate the supporting troops for the first line. This trench, in turn, is protected by barbed wire entanglements and other obstacles.

The support line is constructed like the firing line in respect to fire bays and traverses, and should have good facilities for movement of troops with proper dug-outs and other forms of shelter, as the support line, especially in cases where the front line is very close to the enemy, is more apt to be shelled than the advanced trench, as the front line is protected by the fact that, should the enemy open fire on this trench with their artillery, there is always danger of their fire falling short, or owing to the jogs in the line bursting on their own men.

Communication trenches run from the support line to the firing line, provision being made at the near end of these communication trenches for a fairly long stretch of straight trench, which should contain a machine gun block, under cover of which this gun sweeps the length of the trench. This is for the purpose of preventing the enemy from getting in close contact by means of the communication trenches should they penetrate the front line. Along these communication trenches should be upper gun emplacements, which are able to sweep the open ground, and where possible constructed as in Sketch "H."

Many types of obstacles are used to break up enemy formation throughout the system. Some of these take the form of stake pits, which are excavations in the ground, in which are arranged stakes which are sharpened and put in at an angle of 45 degrees, the end of these stakes not to show above the ground. These should come as a complete surprise to the enemy and help greatly the effectiveness of the machine guns, as, properly placed, they create a tendency on the part of the enemy to bunch as they attempt to run around these pits when advancing, thus presenting a good mark.

Strong points or redoubts should be placed as points of resistance at all tactical portions of the ground throughout the system. These redoubts are protected by barbed wire entanglements which run continuously around them, and should be made as invisible as possible from aero-

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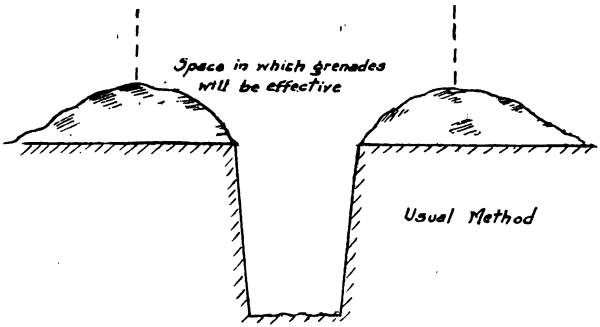

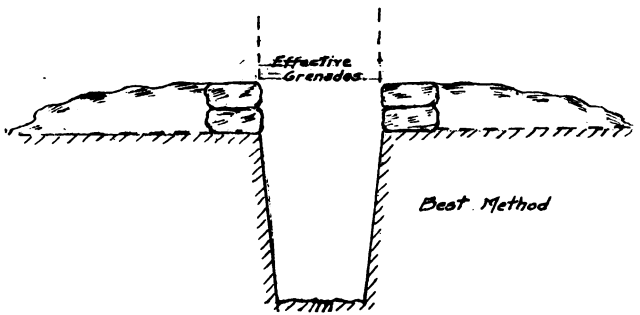

SKETCH "H"

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plane observation. These have usually a garrison of from six to fifty men, depending on their size, and are principally used to break up enemy movements after they have penetrated the front line.

In rear of the support trench, at an approximate distance of from 400 to 600 yards, are the reserve trenches, which may consist of a line of trenches or, more usually, of dug-outs, formed by improving cover afforded by natural features. The reserve is connected to the support line by communication trenches, which should have all protective features possible. In regard to all communication trenches from front to reserve, the policy is to break or change the direction of these at least every 20 yards or 60 feet to give better protection. Jutting off these communication trenches at intervals are small slit trenches, which are made to accommodate about twelve men, and are about 8 to 10 feet deep, and are heavily strutted or braced across the top and, when possible covered; these are to afford protection from artillery fire for troops when moving up to the front line.

The defenses in rear of these front lines should be a zone three or four miles in depth, in which every available natural and tactical points are strongly fortified, and the intention is by the occupation of these points to break up the advance of the enemy and force them back, or at the worst, to delay them sufficiently enough to allow the troops in the rear to reorganize for a counter attack.

USUAL ROUTINE IN THE TRENCHES.

Stand To takes place twice each day. "This consists of the whole trench garrison taking up their positions against the parapet in the first line trench" at dawn and dusk in the evening for one hour each time. This is a precaution always taken, as these are the times the enemy are in the habit of attacking.

Rifles are very carefully inspected by the platoon officers twice each day, morning and afternoon, and in the event of a gas attack being over, the rifles are cleaned immediately.

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A good system of working parties must be adopted so that maximum amount of work will be done daily. Rations for 48 hours are taken into the trenches whenever possible, and quantities of sand bags and stores should always be taken in with each battalion to save time later on, when such duty is possibly more difficult.

Carrying parties are detailed for stores and rations each day. These parties usually go back for same each night under cover of darkness, and should be under the charge of good and reliable N. C. O's.

The routine hours for sending back requisitions for material and the casualty reports are given out in the trenches beforehand.

For the provision of material for requisitions, there is in every brigade a workshop where materials and trench stores are constructed. This shop is under a staff captain and N. C. O., while the ten or twenty men employed here are drawn from the different units constituting the brigade. Every morning requisitions for each battalion are sent to the workshop by each adjutant and the necessary stores sent up to the trenches usually that night by special carrying parties.

Officers must be impressed with the necessity of staying in their particular portion of the trench with their men for the proper supervision and command of same.

The usual rule adopted for the posting of the sentries where trenches are fairly close is by night one man in every four, and by day one man in every ten. Bayonets are fixed in the firing line during darkness, bad weather, etc., when the wind is favorable for an enemy gas attack, and always when the trenches are particularly close.

RELIEF AND OCCUPATION IN THE TRENCHES.

In the training of troops for this most important branch every man must be impressed with the importance of a properly conducted relief, as a properly conducted relief can be carried out safely and expeditiously, while on the other hand, a relief conducted in a careless manner without proper supervision or previous training will very often result in great loss of life and unnecessary danger.

The first requirement is a very careful preliminary reconnaissance. In the case of a regiment or battalion, a party consisting of the commanding officer, adjutant and machine gun officer and one officer and N. C. O. per company will make this reconnaissance, but in the case of new trenches to be occupied for the first time or for an inexperienced regiment, it is often necessary to send one officer and N. C. O. per company into the trenches 24 hours before the unit with the unit's snipers and sharpshooters.

These advance parties secure all possible information, such as:

Condition of wire entanglements.

Work in progress in and out of trench.

Position of enemy machine guns, snipers, etc.

Danger points, etc.

Position of listening posts.

Number of bombs on hand and position of stores.

Position and quantity of small arms ammunition.

Sanitary arrangement.

All methods of communication.

Water supply, rations, etc.

This information, as well as all necessary information, must be gathered at this time.

A system is now in practice in France which is found excellent. A book called the "Trench Log Book" is kept by each company commander, and is supposed to cover each company frontage or sector. In this book all information is kept, including the amount of stores on hand from day to day. This book stays in the trench, being turned over to each relieving company commander, in this way doing away with unnecessary bother and a great saving in time.

THE RELIEF.

On receiving orders to take over and occupy some portions of the line, the brigade staff obtain from the brigade

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to be relieved all possible information; they then make a reconnaissance, accompanied by the brigade machine gun officer; and then arrange how the line is to be held and to whom allotted.

They then notify all the battalion (or regimental) commanding officers the time of the relief and the sector of trenches they have allotted them. The O. C's. then take the necessary steps and make their preliminary reconnaissance as laid out in the above article.

Reliefs are usually made under cover of darkness, unless under very favorable conditions.

On the night of the relief, the whole brigade usually meet at an appointed place in rear of the line to which they have marched from billets. They then move off by battalions (or regiments) with about one-half hour between each unit.

The transports, field kitchens, etc., accompany each unit to which they are attached, but only move up to a point (usually a short distance back of the reserve line) previously agreed upon.

Each battalion moves up to a position in rear of the new frontage they are to occupy; here they are met by guides. From here they will go by platoons, moving up by way of the communication trenches. An officer should be in rear and an N. C. O. in front to prevent straggling. On a dark night the chance of men straying into the cross trenches is very great, so as a precaution and to keep the men together, each man will hold the bayonet scabbard of the man in front till the trench in the front line is reached.

Packs are taken to the trenches and rubber sheets, but no blankets. In cold weather greatcoats will be carried along. Every man will carry three sand bags tucked in the belt; these are later to be left in the trench. No smoking will be allowed, and talking is forbidden after a certain point is reached.

Officers carry revolvers, but not rifles; but may carry blackjacks, which are weighted canes.

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When the Fire trench has been reached, the force move in and line up in rear of the garrison to be relieved, who will stand on the fire step, and when the formality of turning over the trench has been completed, the former garrison will turn in the one direction and move out in single file, the relieving troops taking their places on the fire step with fixed bayonets.

All sentries are then posted in pairs and told off for this duty by an N. C. O., who is told off by each platoon. Once this is done, providing there is no danger of surprise attack, the men not employed on this duty are allowed to retire to the supervision trench and select their resting places, but men of each platoon must have rest places or dug-outs by themselves.

Immediately each company completes its relief, the company commanders will at once notify the adjutant by phone that they have completed their reliefs. The adjutant of each of the battalions will then notify the brigade staff that their battalion has taken over. When all the reports are in, the brigade in turn will notify the divisional staff that the brigade has completed its relief.

MANNER AND TIME OF TRENCH ORDERS.

1. **Returns.**—(a) In the morning report at telephone station at 3.15 a. m. (This hour is altered according to dawn.) If not in by 3.30, no officer may keep the orderly. Only one orderly.

2. Requisition for trench stores to be telephoned to the battalion between 8.45-9.15 a. m., with indication of work proposed for next 24 hours.

3. Casualty reports for last 24 hours, ending 12 noon, to be telephoned to battalion headquarters between 12 and 2.30 p. m. Nil reports to be rendered.

4. Evening reports on work done during day should be telephoned to battalion headquarters between 4-4.30 p. m.

5. Return of stretcher cases for field ambulance to be telephoned to battalion headquarters between 6.15-45 p. m.

INDENTS (ORDER OF THINGS).

Articles such as picks, field S. A. A. boxes, one-leg pumps, pairs of waders, mud scoops, rifle grenades, de-

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tonators for same, blanks for Very pistols, ammunition for rifle grenades, detonators for same, barbed wire, plain wire (anything to do with barbed wire), cross-cut saws, braziers, latrine tins, mallets and rifle rests (for grenades), sand bags, loop holes, boards, should be demanded by 9 a. m.

WORK IN A TRENCH.

Platoons.—Sentry groups of six. Each group provided a double sentry, two men on duty, two men working, and two men sleeping. Reliefs: The man on sentry is replaced by the worker, the man sleeping replaces the worker. In the case of two sentries in one traverse, generally one is posted by day. The whole of the group is then available for work by day. When there is a single group in the traverse, there is only one sentry on the two traverses by day; alternate days, right or left sentries are on the traverse.

N. C. O's.—One always on duty for the whole platoon, not below the rank of full corporal. He is responsible that each man knows who is on duty. He takes all reports by night; always an officer in the fire trench. The officer on duty takes all reports.

Sick.—No man may go sick without M. O's. opinion and without the platoon commander's permission. Sick men's kit must be taken out complete with their rifles and ammunition. If a man is wounded, his own field dressing should be used. Communication trenches should be provided with stretchers.

Equipment never to be taken off. Sleeping caps always to be worn. Breech covers always to be used in wet weather. A piece of flannelette tied over the end of the barrel—this platoon had only three rifles spoiled. Loop holes should have sacking in front of them. Sand bags open end to be in the parapet. Top of parapet should be two headers and one stretcher or three stretchers and one header. Traverses should be well above the height of the parapets. Generally dug-outs should not be in the fire trench; should be well back of trench, 10 yards to

the rear, with backs to the enemy, and should have two exits. Box periscopes should be built into the parapets; no man should lift his head over the parapet by day. Boards should be used for firing steps.

Grenade magazines in fire trench should be placed under traverse or in position above which no man should stand. S. A. A. boxes and main bomb magazines should be 50 yards down communication trench.

Grenades should never be put where bullets can hit them. Bayonets should always be fixed. Snipers loop holes should either be in front or in a small sap in front of parapet. Snipers should not fire straight to the front.

Periscopes can be made out of chimneys in ruins of houses near the lines by two mirrors, top and bottom of chimney.

A good man can rig up about 25 sand bags in an hour. Trench sentries should look with the old sentry for four or five minutes, then put up heads slowly.

Barbed wire, if possible, should be carried out at once and rolled in a line if the night is dark. Do all hammering last; welts should be laced with smooth and barbed wire; welts well pegged down. Loose wire in front of entanglement is good.

Low entanglements more practical than high pickets. Pits with spikes useful. No lights to be seen from dug-outs in fire trench, but should be screened so as not to shine on sentries. No coke fires allowed in dug-outs. Orilax best lamp. Steward will send refills—two per week.

Guards.—One man per traverse wakes all men in dug-outs. Any sentry gives the word at once. On receiving word, all men turn out and get on firing platform at once. Men have a tendency to poke their rifles over the trench and fire in the air.

Cause of jambing in rapid fire is dirt on cartridge case which gets into the parts of the chamber behind the rim, strains the extractor spring, and clogs the barrel (British rifle). In going out of trench, unload before reaching the billets. Constant examination of arms necessary.

Rifle Grenades.—Never fire from the shoulder. Newton firers seem most accurate. Shots will go within 4 square yards with the heel on parapet, if hard in, and gives as accurate results as wooden stands. Special rifle to be used.

If shelled, report anything known of direction from which shells are being fired.

Send guides to lead reliefs to trench.

Report to battalion headquarters as soon as relief complete.

Do not fire for twenty minutes before reliefs arrive. Reliefs should not fire for twenty minutes after entering trench.

Guides meet water and ration parties.

In going to trench, go slow. Officer or N. C. O. always in rear. Practice passing orders. Silence on approaching trench.

Guides reconnoiter paths to different trenches—two per platoon.

THE PREPARATION AND ASSAULT OF TROOPS FROM THE TRENCHES.

Preliminary Preparation and Method of Assault, With Part Taken by Bombers.

The guns of the artillery will open up and prepare the way for the advance of the infantry according to exact time laid down in the scheme of the operations as issued. As all watches have been synchronized, the timing of the different movements must be exact and to the second.

The guns during this time will concentrate their fire by a violent bombardment of the enemy's obstacles and his defenses. Heavier or siege batteries will concentrate their fire at the same time back of the enemy's lines in an attempt to silence enemy batteries, which will open up their fire of retaliation immediately our guns start.

This bombardment will probably take considerable time, and during this period the strength of our front line trenches should be temporarily reduced to avoid heavy casualties from enemy's retaliation.

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Trench mortars and howitzers will open up and co-operate with the artillery in the cutting of enemy obstacles and in the prevention of any enemy attempt to repair their destroyed works. It is at this time, when it is so necessary that all enemy obstacles be wiped out and machine gun positions destroyed, that the fullest co-operation between the infantry and the artillery is required.

The bombardment is kept up till the moment fixed for the troops to bring home the assault. The infantry meanwhile, just previous to the lifting of the barrage, have taken up a position lying just outside their own barbed wire defenses, or in a jumping off trench immediately forward of their entanglements. They start forward in a succession of waves, consisting of men extended at about one man every two yards and about 50 yards between waves. The number of waves will depend on the objective to be reached and the number of trenches to be taken. The moment the artillery barrage lifts from the enemy first line trenches to a position between the firing line and the support, the infantry will follow closely on, keeping as close to the barrage as possible, and the men who have been moving forward at a moderate pace will fiercely attack the front line. Clearing up or mopping up parties will follow up, each wave to deal with enemy in dug-outs, take charge of prisoners, etc.

The fire of the artillery in the meantime being concentrated on the ground between the enemy firing line and support, helps out to the following extent, i. e.:

Prevents supporting troops from reaching the front line.

Prevents the sending up of ammunition, stores, etc.

Causes confusion and panic among the enemy occupying this ground.

In the event of two lines being the objective, the first attacking wave, with its attendant clearing parties, etc., will occupy the first line taken and remain there, while succeeding waves of attacking infantry will cross this first trench captured and deal in turn with the next line.

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Where the artillery barrage is delayed in lifting to clear the second line, the wave or waves of infantry detailed to take the next objective will temporarily occupy ground first captured, under cover till time to move forward arrives.

The formation of the assaulting waves and their composition vary from time to time. A good method which may be adopted and has been found very successful is to have in the assaulting wave automatic rifle sections, bombing parties and the regular infantry properly distributed. Immediately behind the assaulting waves come the clearing up parties and reinforcing sections.

The company commander will usually take his place with the last mentioned formation. The platoon officers will usually be found in the center of their platoon as extended. The reinforcing sections will usually follow the wave at a distance of about 40 paces. The moment the objective is reached, machine guns are placed in position and the work of consolidation of these trenches is rushed forward by the working parties, usually under Royal Engineer supervision, and careful preparation must be made to withstand any counter attacks which the enemy are sure to bring to bear soon after. Machine guns placed in positions such as crater holes, etc., forward of the trench captured, will be found invaluable during these counter attacks.

The success of all assaults depends for its success on the following:

The thoroughness of the preliminary orders and their understanding.

The preliminary reconnaissance of the enemy frontage

Proper arrangement for assurance of a continual supply of munitions and material during the attack.

Full provision for inter-communication between the different arms.

The proper distribution of snipers throughout the line

Proper bombing provision to be made for all enemy communication trenches leading to their front line.

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Liberal provision of reserves to take the place of casualties.

Morale and physical fitness of the troops engaged.

ACTION OF THE GUNS DURING AN ATTACK.

At the moment fixed for the assault, the artillery fire will lift from the actual places to be assaulted, but will be kept up on the immediate flanks where necessary. After the assault is under way, the artillery will try to keep down fire of enemy artillery.

By barrage fire between objective and its supports. Prevent reinforcements from coming up to help out the forward garrison, special attention being directed towards the communication trenches and other lines of approach.

They will give constant support to the infantry by dealing with strong points or points of resistance which may hold them up in their forward movement.

Where the position allows, a proportion of fields guns, dug in close to our front line, will give good support during the advance.

SITUATION REPORTS.

All officers are held accountable for situation reports. They must keep their superior officers and neighboring units informed of the progress of events and any important changes in the situation or movement of their own or enemy troops. These reports are called situation reports.

Training should be very thorough in this respect, and it should be a continual thought in the mind of every officer during an action of any kind. In sending situation reports, great care should be taken to make them clear and understandable and as brief as possible. In telephoning these messages, they must be very brief, as the lines of communication are sure to be busy and any message might interfere, if prolonged, with more important communications.

It is sometimes best for officers to send in rough sketches to designate any taken position with reference to a trench map if possible. The use of special observers for this work will be found of great advantage.

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PRECAUTIONS IN CASE OF ATTACK.

The main points to be taken as a precaution in case of enemy attack are as follows:

To stop from the first any attempt of the enemy from actually leaving their trenches, by concentration of machine guns, rifle and artillery fire, backed up by the free use of trench mortars, etc.

At night, in addition by the constant use of Star shells, etc., to keep the movements of the enemy under observation.

A sudden counter attack without delay should be made. The enemy having gained an entrance, this will usually catch them somewhat unprepared, so that arrangement of troops for immediate counter attack should be made. Strong points and redoubts made for all around defense must be held to the last. Their object being to break up the enemy attack and gain time for the organization of a counter attack.

A temporary withdrawal of the bulk of a trench during a very heavy bombardment by the enemy is sanctioned when necessary. Should the enemy gain a footing in the front line, they must be forced out immediately, which is usually done by squads of bombing parties, and before they have had time to properly establish themselves. The supports in rear should automatically reinforce the front line if required, and to counter attack at once if the front line is taken.

The battalion reserve is used to maintain the front system of trenches by counter attack, or if not sufficient for that purpose to take up good positions, to check further enemy advance.

The brigade reserve will work along lines similar to the above and according to circumstances. Alarm signals, etc., must be made provision for in the trenches, so that all lines are instantly warned should an attack be launched.

The artillery co-operates as laid down in "Co-operation of Artillery and Infantry."

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The following dumps are normally required at the front:

A main divisional dump at tramway terminal.

An advanced divisional dump well forward along tramway line.

One or more brigade dumps in vicinity of brigade battle headquarters.

Battalion dumps near battalion headquarters.

Trench dumps in front line and support trenches.

Sub-dumps scattered at best points along the front line and in positions along communication trenches.

All perishable stores should be kept in bombproof dugouts.

All dumps should contain the following:

Small arms ammunition.

Grenades, hand and rifle.

Very lights (Star shells).

SOS rockets.

Aeroplane flares.

As a general rule the following stores are kept in main divisional dumps:

Stokes mortar ammunition, trench mortar ammunition and P. grenades.

Royal Engineers' stores, i. e., picks, shovels, sand bags, wire cutters, tape, timber, etc.

Advanced divisional dump:

Same as above, omitting wire cutters and timber.

Brigade dump:

Stokes gun ammunition, trench mortar ammunition and P. grenades.

Royal Engineers' stores, i. e., picks, shovels, sand bags, tracing tapes, measuring rods, wire and screw pickets.

5,000 bully beef rations.

Biscuit and rum rations.

200 petrol tins filled with water.

Battalion dumps:

Royal Engineers' stores, i. e., picks, shovels, sand bags, wire and screw pickets.

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100 petrol tins filled with water.

Trench dumps:

No special Royal Engineers' stores are required here, but all tools and stores already in trenches should be gathered up at these dumps.

A special officer is detailed, who generally supervises all brigade dumps, etc.

PENETRATION.

The following thicknesses of material have been found necessary to stop the German Mauser bullet:

Earth, dry	3 ft. 6 in. to 4 ft.
Earth, wet	4 ft. 6 in. to 6 ft.
Broken brick	8 in.
Sand, dry	3 ft.
Sand, wet	4 ft. 6 in.
Coal	8 in.
Sand bags, headers	2
Sand bags, stretchers	3
Steel plate	½ in.
Brick work	10 to 15 in.
Iron plate	1 in.

Note.—The above are not proof against the (exceptional) steel bullets.

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HASTY DEMOLITIONS WITH EXPLOSIVES.

General Remarks.—The service explosives available for hasty demolitions in the field are guncotton and cordite. Other explosives may sometimes be obtained, the most likely being gunpowder and dynamite. Where a lifting effect is desired, gunpowder should be used; but when a cutting or shattering effect is necessary, one of the others (high explosives) is better.

Guncotton.—1. Guncotton is carried in the field for demolition purposes. It is compact in form, safer than most others to transport and handle, and, like all high explosives, can be used without tamping.

Dry guncotton in small quantities will only burn away fiercely when ignited, and will not detonate if struck by a bullet. It will detonate if struck between two hard substances, and becomes more sensitive to percussion when heated through friction or by the sun.

If a small quantity of detonating substance such as fulminate of mercury be exploded in contact with dry guncotton, it will detonate with great violence, and also cause the complete detonation of any wet or dry guncotton with which it is in contact.

Guncotton will absorb about 30 per cent. of its weight of water, and when wet does not ignite or detonate easily, though the explosive force is slightly greater than when dry.

Consequently the bulk of guncotton is carried and used wet in the shape of "slabs." For detonating this, dry guncotton, in the shape of small discs called "primers," are also carried in air-tight tin cylinders, each containing 10 primers.

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2. The slabs and primers for field service are as follows:—*

i. Slab.—Weight 15 oz. Dimensions 6 inches x 3 inches x 1⅜ inches, with one perforation for the primer. Each slab is in an hermetically sealed copper-tinned case.

ii. Primer.—Weight 1 oz. Dimensions 1.35 inches to 1.15 inches in diameter by 1.25 inches long, with one perforation for the detonator. The primer is conical in form.

The slabs can be cut without danger with a sharp knife or saw, care being taken to press the guncotton between boards whilst it is being cut to prevent it flaking away. There is a special clamp in the R. E. equipment for doing this. The guncotton must be well soaked with water during the process.

3. A charge of wet guncotton is detonated by means of the explosion of a dry primer in close contact with it. The primer is exploded by means of a "detonator," containing an explosive which will detonate by the direct application of flame. The detonator is fired by means of either "safety" or "instantaneous fuse," which is lit by a fusee or other means.

If dry primers are not available, a piece of wet guncotton can be dried by exposure to the sun, and used instead. To test whether guncotton is dry, hold a piece of warm glass against it; if damp, a film of moisture will be left on the glass. When used in such places as bore holes in rock, guncotton must be dry; but a plastic explosive is more suited to such work.

4. A charge is connected up for detonation as follows. The fuse (safety alone or safety with instantaneous) is cut to the required length. The end to be ignited is cut on a slant to expose as much of the composition as possible. The end to be inserted in the detonator is cut straight across. The straight cut end is then gently inserted into the open end of No. 8 detonator, from which the paper cap has been torn. This end of the detonator is then pinched (or with old-pattern detonator slightly bent) to make it grip on the fuse and so prevent its being withdrawn.

* The following may still be found, in addition to sizes used in the naval service:
(a) Slabs, 1¾ lbs. and 1½ lbs. (known as "S" and "T" respectively).
(b) Primers, 2 oz. and 1 oz. (known as "F" and "H" respectively). These are cylindrical.

(Cavalry pioneers carry detonators with two feet of safety fuse ready fixed, the fuse having a piece of quick-match added to the end to facilitate lighting.)

The primer having been tested to receive a detonator is placed in close contact with one of the slabs of the charge, either in one of the holes or tied to a slab, and the small end of the detonator is gently inserted into it so as to fill the entire length of the hole. If the hole is too large, a piece of paper or grass must be wrapped round the detonator to make it fit tightly; if too small, it must be enlarged with a rectifier or piece of wood, but not with the detonator.

5. The charge must be in close contact with the object to be demolished and each slab must be in contact with those next it.

The charge must extend across the whole length of the object to be cut. One detonator is sufficient for a continuous guncotton charge.

Arrangements must be made to prevent sparks from the fuse falling on the guncotton, and so setting it alight instead of detonating it.

6. The amount of guncotton (untamped) required for various charges can be calculated or obtained direct from the table on page 113.

Where B = length to be demolished in FEET.

T = thickness to be demolished in FEET.

t = thickness to be demolished in INCHES (in the case of steel or iron plate only).

NOTE.—The charge is in lbs.; if the charge is tamped, the amount can be halved. Masonry includes concrete, stone, or brickwork.

In the presence of the enemy, charges may be placed hurriedly, and so under favorable conditions, and should therefore be increased by 50 per cent.

For emergency purposes BT^2 is effective with all classes of masonry and $2Bt^2$ for all steelwork. A slab will cut its own thickness of steel plate.

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GUNCOTTON

OBJECT ATTACKED	lbs.	REMARKS
Masonry arch—haunch or crown.	$\frac{1}{4}BT^2$	Continuous charges.
Masonry wall—up to 2 ft. thick.	2 per foot	Length of breach B not to be less than the height of the wall to be brought down.
Masonry wall—over 2 ft. thick.	$\frac{1}{2}BT^2$	
Masonry pier	$\frac{1}{2}BT^2$	
Hard wood—stockade or single.	$3BT^2$	In a single charge outside. For a round timber charge $=3T^3$. (Soft wood half this.)
Hardwood—auger hole ...	$\frac{3}{8}T^3$	Where the timber is not round, T—smaller axis. (Soft wood half this.)
Stockade of earth between timber up to 3 ft. 6 ins. thick.	4 per foot	Single charge outside.
Heavy rail stockade ...	7 per foot	
Fort Gate	50	
Breechloading guns ...	——	For 8-inch gun use 2 lbs. Double the charge for every inch increase in calibre.
First class rail	1	Charge fastened against the web near a chair (if used).
Iron or steel plate ...	$\frac{3}{4}Bt^2$	t is in INCHES.
Frontier tower, stone and mud.	——	5 lbs. plus 1 lb. per foot of longer side if rectangular, or of diameter if circular. In one charge in centre of tower.
Steel wire cable	1	Up to 5 inches circumference; above 5 inches $\frac{C^2}{24}$C being circumference in inches.

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GUNPOWDER.

1. Gunpowder is not so useful for most hasty demolitions as guncotton, except where a lifting and shaking effect is required, and the larger the grain the less suitable is it, owing to its slow rate of burning.

2. Gunpowder charges must be tamped, and should be made up in as compact a form as possible. The powder should be placed in a well-tarred sandbag, or, failing that, in one sandbag inside a second one. About half the powder should first be poured into the bag, and then the safety fuse, knotted round a stick to prevent its being pulled out, should be inserted, a piece of stout wire or a withe, being also attached to the stick, to help to support the fuse after it leaves the mouth of the bag. The rest of the powder is then poured into the bag, and the mouth secured with spun yarn, so as to make it easier to carry, a last seizing of the spun yarn being made round the fuse so that any pull on it will fall on the spun yarn and not on the fuse itself.

The length of fuse to be employed should be measured outside the bag.

3. A service sandbag will hold about 40 lbs. of gunpowder, which is about as much as a man can carry conveniently. When a charge has to be placed under fire, and the amount is greater than this, it should be divided amongst several bags, rather than put into one large one. In any case only one bag need be fused.

4. A gunpowder charge should generally be divided up into equal portions, which should be placed at a distance apart equal to twice the thickness of the object to be demolished. The several portions must be fired simultaneously.

5. The amount of gunpowder (tamped) required for various charges can be calculated from table on page 126.

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CORDITE.

1. Cordite for demolitions may be obtained from gun cartridges.

For demolition purposes cordite is uncertain in its action and should only be used when no better explosive is available. The small sizes are the more reliable.

It is fired similarly to guncotton; a primer of guncotton or other high explosive must always be used.

2. A cordite charge should be bound up tightly and fixed firmly against the object of demolition. It should in most cases be tamped, but this is not necessary when used against metallic structures, e. g., rails and girders. No portion of a cordite charge should be more than 12 inches from a primer, since the rate of communicating detonation is slow.

An untamped charge must be well protected from possible sparks from the fuse, since cordite ignites very easily.

3. Where good contact can be obtained, the power of cordite may be taken as equal to guncotton, otherwise a cordite charge should be increased by about 25 per cent.

DYNAMITES.

1. Dynamite, gelignite, gelatine dynamite, and blasting gelatine are often procurable in a mining locality, and can be used instead of guncotton. For military purposes the only advantage they have over guncotton is that, being plastic, they are easier to fit into narrow and irregular holes and spaces as for blasting rock and cutting steel work. For demolishing masonry dynamite is not so good as guncotton, as its action is even more local.

It cannot be used after exposure to wet, which separates the nitroglycerine and makes it dangerous.

2. Dynamites freeze at 40° F., and remain frozen at higher temperatures. When cold weather is likely, they should be buried a foot or two underground. Frozen dynamites can be distinguished by being harder than unfrozen, by being more brittle than plastic, and being of a slightly lighter color. Frozen dynamites should be thawed before use, but this must be done with great care and only small quantities should be dealt with at a time.

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Frozen dynamites must not be warmed on or near fires, stoves, ovens, or steam pipes; nor exposed to the direct rays of a tropical sun. They can be thawed in a water-tight tin can, which should be placed in a vessel containing water previously and separately heated to a temperature not hotter than the wrist can bear. A proper "dynamite warming pan," which cannot be placed on a fire without destroying it, should always be used if possible.

3. They are usually obtained in 2 oz. cartridges wrapped in parchment paper, in boxes of 5 and 50 lbs.

4. They can be detonated by fuse and No. 8 detonator, or by fuse and cap; the former is unnecessarily strong.

They are fired in a similar manner to guncotton, but no primer is required. The detonator with fuse attached is inserted into a hole made in one of the cartridges, and tied in position. This hole must be made with the rectifier or a piece of wood. Where a dynamite charge requires ramming, as in a bore hole, each cartridge must be gently squeezed into place with a wooden rammer, the fused one being the last.

5. The relative strengths of the common explosives, when well tamped, may be taken as follows: Gunpowder 5, cordite 8, dynamite 3, guncotton 10, gelignite 10, gelatine dynamite 12, and blasting gelatine 13. For use under water dynamite and similar explosives should be tied in a waterproof bag.

6. Although complete detonation is impossible with frozen dynamite, an explosive effect roughly half that of thawed dynamite can be obtained by using a thawed cartridge as primer. Frozen dynamite will explode by simple ignition at a temperature of about 360° F.

DETONATORS

1. No. 8 detonator consists of a brass tube painted red, the small end of which, A, contains the detonating compound (fulminate of mercury); above this is a wooden plug with a hole in it, through which passes a piece of quick-match. The upper end of the tube is empty, for the insertion of the fuse, and is closed by a small paper cap.

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These detonators are packed in tin sealed cylinders painted red, which contain 25. No. 8 detonators will detonate dry guncotton, but it will not detonate wet guncotton or cordite without a primer. Both safety and instantaneous fuse can be connected to it. The older Mark III detonator may still be met; it is longer than Mark IV and has no lugs. A Mark V detonator has now been introduced. It is similar in appearance to Mark IV, but the body is made of copper.

2. Where dynamite, etc., is found, a smaller kind of detonator used in civil works will often be available and should be used in preference to No. 8 detonators as being more economical. This is made of copper, and contains less fulminate than the No. 8 service detonator.

These "caps" vary in size and strength (sizes 3 to 10). To detonate dynamite, size 3 are used as a rule. The weaker sorts cannot be counted on to detonate guncotton primers, but for all dynamites, size 6, 7 or 8 (the latter for blasting gelatine) are strong enough.

They can be connected up to safety or instantaneous fuse.

3. Detonators must be stored apart from explosives. To prevent them being exploded by stray bullets, they may be buried.

SAFETY FUSE.

1. The present pattern of safety fuse is known as "Safety, No. 9." It consists of a train of fine gunpowder enclosed in flax twist, covered with gutta-percha and waterproof tape. It is packed in tin cylinders containing 8, 24, or 50 fathoms.

It is colored black.

Safety fuse will burn under water.

2. For practical work the rate of burning can be taken at 4 feet per minute; but all fuse should have its rate of burning tested before being used. Fuse which has been more than six months or so in a tropical climate should be very carefully examined and tested.

3. It is difficult to light safety fuse with a match or flame. A portfire or vesuvian (fusee) is best, but in the

absence of such means of ignition, the head of a match inserted in the fuse and lit by another match or rubbed by the prepared portion of a matchbox, is usually successful.

INSTANTANEOUS FUSE.

1. Instantaneous fuse consists of three strands of quick match enclosed in flax and several layers of gutta-percha and waterproof tape. It is colored orange. It is used, in the absence of electric appliances, when the time taken to burn the requisite length of safety fuse would be inconveniently long.

2. It burns at the rate of 30 yards a second, or practically instantaneously; it is packed in sealed tins holding 100 yards.

3. It can be distinguished in the dark from safety fuse by feeling the open crossed thread, snaking outside.

Unless the safety of the firer or the depth of the tamping requires it, instantaneous fuse should not be used in addition to safety fuse where there is only one charge, as it increases the liability to missfire.

4. It is liable to jerk the detonator out of a charge by its violent jump on ignition, unless it is carefully secured near the detonator.

SUBSTITUTES FOR FUSES.

1. If the service fuses are not available, gunpowder, mixed with water, ground into a fine paste between two pieces of wood and then pressed into a tube, may be used instead of safety fuse. Its rate of burning will vary according to the dampness of the powder.

2. Instead of instantaneous fuse, powder hose made by filling tubes of linen with fine powder may be used. The tubes may be from ½ to 1 inch in diameter, and up to 20 feet in length. The rate of burning will vary from 10 to 20 feet per second.

FIRING CHARGES.

1. When firing charges with instantaneous fuse, a piece of safety fuse should be joined on for lighting, in order to allow time for getting away, except as described in paragraph 5 below.

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2. Safety and instantaneous fuse may be joined in three ways:

(a) Cut the instantaneous fuse on the slant so as to expose the quickmatch for a short length, and treat the safety fuse in the same way, taking care that the composition is well laid open. Join these two surfaces together and bind up tight. A small piece of wood is useful as a splint, and, if available, a little powder or quickmatch can be put between the two fuses.

(b) Place the ends of both fuses in a small bag of gunpowder, exposing the quickmatch of the instantaneous fuse for two inches.

(c) Cut a semi-circular nick in each fuse near the ends, exposing the core of each. Put the nicks together and tie them together tightly.

3. To join two lengths of instantaneous fuse slit the outer covering of each piece of instantaneous fuse at the end, so that it can be turned back to expose the quickmatch; the strands are then twisted together, the outer covering made to overlap the joint, and firmly fixed with twine.

4. Joints in fuse can be made waterproof by wrapping them round with India rubber tape smeared with India rubber solution, which are articles of R. E. equipment. Ordinary tape and tallow would do for a short time against damp.

5. When several charges are to be fired simultaneously and electricity is not available, it may be done by using equal lengths of instantaneous fuse, which are ignited by a length of safety fuse.

The joint at "b" can be made with a small bag or box of gunpowder or flaked guncotton, into which the end of the piece of safety fuse and the ends of the instantaneous fuse are led, the quickmatch in the latter being exposed for two inches. Care must be taken that the lengths of instantaneous fuse are equal, irrespective of the distance from the powder box to the charges. This method cannot be relied on to give certain results.

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PRECAUTIONS TO BE OBSERVED IN FIRING CHARGES.

1. When a demolition is to be carried out under fire every precaution should be taken against a possible failure; spare men should be detailed to replace casualties amongst those carrying the stores and every man with the party should have the means of lighting the charge, and should know exactly what is to be done and the means available.

2. For large charges of all sorts which cannot easily be got at after tamping, and for demolition work where certainty and rapidity are essential, it is a good rule to insert and light two fuses (and detonators if required) in the charge in case one should prove faulty.

3. When pinching or bending the mouth of a detonator or cap to grip the fuse, care should be taken not to squeeze the detonating end, or to point it at anybody.

4. When tamping a guncotton charge with earth, stones, etc., the detonator should be protected from blows, and the fuse from wrenches which might displace it. The fuse should also be lightly fixed or weighted so that when lit it will not curl up and set the charge on fire.

5. When a charge fails to explode, it should not be approached for at least half an hour. In accessible places the charge should be "killed" by detonating a fresh charge as close as possible to it. When it is necessary to withdraw the charge, the tamping must be carefully cleared away from the detonators with pieces of wood, the whole being previously drenched with water, and the detonators removed at the earliest opportunity.

6. The person who orders a charge to be fired is responsible that surplus explosives and detonators, etc., have been removed to a place of safety, and that steps have been taken to insure the safety of people ignorant of the place and time of the explosion.

7. Where several charges are to be fired without awaiting successive explosions, all fuses within the danger area of any one charge should be lit by one person only, allowance being made in length of the fuses. They should not be lit by men acting independently.

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BRICK, WOOD AND MASONRY DEMOLITIONS.

1. For the demolition of brickwork or masonry with guncotton, the charges worked out by the formulae in the table will sometimes be too small to allow the whole of the length to be cut, to be covered with slabs in contact with one another. In this case add extra slabs. The old pattern slabs, which are larger, may be halved.

2. When it is desired to make a gap in a bridge or viaduct in which there is a series of arches, the best result is got by cutting a pier and so bringing down two or more arches for each charge, but in hasty demolitions this can only be done when the piers are thin.

The best explosive to use for this purpose is guncotton. The charge should be placed where the section of the pier is smallest, and if possible a groove should be cut in the pier for the charge; this reduces "T" and also to some extent tamps the charge. Otherwise the charge should be tied in a continuous strip along a board, which is then fixed with the guncotton next the pier.

If gunpowder is to be used, the whole charge should be divided up as described on page 126, and placed in pits dug at the foot of the pier to be destroyed. If the piers are in water or if time is important the arches should be attacked.

3. The amount of guncotton and gunpowder required for cutting short and thick piers is prohibitive, and the arches should be attacked. The best method of doing this is to place a charge at each "haunch" of the arch. This insures a much larger gap being made than if only one charge were placed at the "crown."

If guncotton is used, a trench must be dug down to the back of the arch ring at each haunch, then the slabs should be laid along the trench on the back of the arch ring. The amounts of explosive required to cut the portions of arch ring protected by the parapet walls being piled up, at the ends of the trench, against those walls. Tamping may be used, but is not essential.

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If gunpowder be employed, the charge for each haunch should be divided as in Sec. 4, the outside ones being placed twice the thickness of the arch-ring from the side walls, to avoid the charges blowing out through the latter. A pit must be dug for each portion of the charge down to the back of the arch, and tamping is necessary equal to twice the thickness of the arch.

In all cases the charges at both haunches should be fired simultaneously.

4. When there is not enough time to reach the haunches, the crown may be attacked in a similar way, but the result is not so satisfactory.

5. When the filling over the crown is deep or traffic must not be interrupted, arches can be cut by guncotton without digging through the roadway. The charge to cut through the arch at the crown is tied in a continuous strip along a plank, and held up underneath the arch by ropes from the parapet, with the guncotton next the arch. These ropes should be windlassed up tight so as to insure contact between the guncotton and the arch; and the plank should be supported or trussed to prevent sagging in the middle.

If the demolition of a bridge does not immediately follow the preparations, steps must be taken to preserve fuses, etc., from injury by traffic or weather.

6. To demolish a wall by guncotton, a groove should be cut for the charge in the wall; if this is not possible, the charge must be laid against the wall. With gunpowder the total charge should be divided up, as on page 126, and earth tamping must be used.

To bring down the top of a wall, the charge must extend over a length not less than the height of the wall.

7. For weakly-built houses, place a charge in the center of each room, shutting all doors and windows. In houses with chimney stacks the charges should be placed on the hearths of fireplaces, if possible, fire charges simultaneously by electricity. The amount of explosive required depends on the size of the rooms and the nature

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of the walls. Mud huts up to 18 feet square, with walls 2 feet thick at the bottom, have been destroyed by about 4 pounds of guncotton placed inside the hut in one corner, all openings being closed; 6 to 12 pounds of guncotton will probably destroy a four-roomed cottage. For strongly-built buildings it may be necessary to attack the walls.

TIMBER DEMOLITIONS.

1. It is more economical to destroy bulks of timber by cutting them down or burning them than by explosives, which should only be used when time presses.

Guncotton or dynamite is the best explosive for this purpose and is most economically used when placed in auger holes bored horizontally at the required height. For baulks up to 18 inches diameter one auger hole bored right through, if necessary to contain the charge, will suffice; the middle of the charge coinciding with the center of the timber. For larger baulks two or more holes bored alongside each other will be needed.

If of guncotton the whole charge should consist of primers, earth of clay being used for tamping. The fuse may be hung on a nail or splinter to take the weight off the detonator.

Timber may be made to fall in any required direction by getting a strain on it beforehand with a rope.

2. The most convenient way to prepare a guncotton charge for use against a stockade, wall, etc., is to tie the slabs beforehand on to a board so as to insure their being in contact with one another; a hole may have to be cut in the board for the detonator and fuse. The board can then be carried up, placed with the guncotton between it and the stockade, and two pickets driven into the ground to keep it in position, or it may be hung on a couple of nails hammered into the stockade.

3. Before attempting to place a gunpowder charge against a gate or stockade, the men carrying the charges and tamping bags should be thoroughly drilled as to how the charge and tamping is to be placed. The men carry-

ing the powder bags on their shoulder lead the way, place the bags against the stockade, fuse down-wind, so that sparks will not blow into the charge, and one prepares to light. The other men, each carrying a bag of sand, place them as shown in Fig. 5. The fuse is then lighted and all get under cover as quickly as possible.

RAILWAY DEMOLITION.

1. On railways, the easiest parts to attack in hasty demolition are the bridges.

Where there is a choice between masonry and iron girder bridges, the girder bridge ought, as a rule, to be attacked, as its demolition will be quicker, guncotton will be economized, and the result will usually be greater.

2. Iron and steel bridges may be destroyed by placing charges of gunpowder or guncotton beneath the ends at the supports; but the quickest way with small girders is to actually cut the girders themselves with guncotton.

The best position in which to place the charge varies in different kinds of bridges, e. g.:

(a) When the girder is of uniform section and only extends over one span, it is near one point of support. This form of girder is met with in small bridges only.

(b) When the girder depends for its strength principally upon a lower tension boom, cut the lower boom for certain.

(c) In a plate girder not of uniform section, only extending over one span, it is just before the first thickening plate on the flanges. If continuous over several spans it is on the shore side of the first pier.

All girder bridges have at least two main girders which carry the flooring and go right across the span, and these main girders alone need be attacked.

3. Nearly all girders consist of a top and bottom "flange" or "boom," connected by a "web," which may

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either consist of continuous plating or of open cross bracing.

The amount of guncotton required for demolition is obtained as follows:

(a) Flanges. Taking the formula for steel plate (see page 109), the breadth of each flange will represent "B," while "t" will be the thickness of the flange plates, plus the thickness of the angle-iron (if any), plus the height of one rivet head (if any).

(b) Web. This is considered as consisting of three parts. The thicknesses of the top and bottom portions are taken as the thickness of the single plate forming the main web, plus the maximum thicknesses of the angle-irons (if any), plus the height of one rivet head. The breadths "B" are measured from the angle of the angle-iron to its edge along the web. The center portion, between the top and bottom angle-irons, is taken as a single plate.

The total charge so obtained is divided into two parts, in proportion to the metal in the upper and lower halves of the girder (often equal), and placed in the diagonally opposite angles formed by the junction of the web with the top and bottom flanges. The spaces between the rivet heads must be packed with clay to provide a uniform surface for the charge to rest on. The latter is kept in position by strutting it against the opposite flange. The two charges must be fired simultaneously.

The total charge is 13.15 lbs. or just 14 slabs. This should be placed as shown in the figure in two charges of 6 and 8 slabs respectively.

So long as there is sufficient explosive available, however, one of these charges should be increased so as to cover the web between the charges.

5. For hasty demolition of railway girder bridges when there is not time to measure the section of the girder, the following formula will give sufficiently accurate results within the limits stated:

$$C = \frac{L^2}{15D}$$

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GUNPOWDER

OBJECT ATTACKED	lbs.	REMARKS
Masonry arch—haunch or crown	$\frac{1}{2}BT^2$	Total amount divided into charges and placed at intervals of about twice the thickness of the masonry.
Masonry wall		
Wood stockade — hard wood.	40 to 100	One charge. Soft wood half this.
Stockade of earth between timber up to 3 ft. 6 in. thick.	100 per 7 ft.	Charges twice the thickness of stockade apart.
Fort Gate....	200	One charge.
Tunnels	$\frac{1}{2}T^3$	Where T=total distance from the surface of the lining to the charge.

Where B=length to be demolished in FEET.
T=thickness to be demolished in FEET.

NOTE—In the presence of the enemy charges may be placed hurriedly and so under unfavourable conditions, and should therefore be increased by 50 per cent.

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where C = charge of guncotton in slabs (15 ozs.), including the allowance of 50 per cent. for the presence of the enemy.

L = length of girder in feet.

D = total depth of girder in feet.

This formula gives the charge required for one girder of single line of standard railway. The charge must be placed near an abutment and be divided up and fixed to the girder in the manner described above.

The formula is applicable to girders of spans varying from 20 feet to 80 feet. Where one girder has to bear the whole load of a line of railway, e. g., two girders carrying a double line, or a center girder carrying half of two single lines, the amount given by the formula should be doubled. This will, however, give rather more than the necessary charge.

Example.—The girder shown in Fig. 1 requires a charge of 14 slabs, or, allowing for the 50 per cent., 21 slabs. The above formula gives 20 slabs.

6. To cut rail the charge should be tied tight into the web close to a chair on the same side as the key (Fig. 2), or in the case of a heavy unchaired rail, as Fig. 3. In the hasty demolition of a railway line care must be taken that the break is sufficiently broad, or sufficient damage is done, to insure the stopping of traffic.

7. An effective way of damaging a railway line is by firing charges at points and crossings.

8. In carrying out the destruction of girders and rails with high explosives, it should be recollected that fragments are liable to be blown 1,000 yards away from the spot where the demolition is being carried out.

9. Blowing in tunnels is a good way of stopping traffic, but to be effective a considerable amount of time and a large quantity of explosive are required.

The points attacked should be some distance within the tunnels, and it is better to blow down one long tunnel in several places than several tunnels in one place only

The crown or the haunches should be attacked as in cutting arches, and the lining should be brought down for some distance along the length of the tunnel. In hard soil not much damage will be done by merely cutting the lining, as very little of the soil may fall. The charges should be placed in chambers, branching off the gallery dug in from the surface of the tunnel, as far back from the interior surface of the arch as time and explosive available will allow, and twice as far from each other as from the surface.

Gunpowder is the best explosive for this purpose.

For calculating the charge, T should be taken as the total distance from the surface of the lining to the charge.

DESTRUCTION OF GUNS.

To destroy a gun with guncotton (or cordite), a shell having been loaded in the ordinary way, the charge necessary for the destruction of the gun should be packed in behind it so as to be in close contact with the shell and with the sides of the chamber. After the insertion of the primer, sods, earth, paper or other material that may be at hand should be used to keep the guncotton in position. The breech should then be closed as far as possible, just allowing room for the safety fuse or electric leads for igniting the charge. A shell is not absolutely necessary for destroying a gun by this method, but, if available, its use increases the effect.

The charges required for guns from 3-inch to 6-inch calibre are given by the following rule:

"For a 3-inch gun use 2 lbs., and double the charge for every inch increase in calibre, e. g., for a 4-inch gun use 4 lbs., and for a 5-inch, 8 lbs. With cordite charges add 20 per cent."

Muzzle loading guns can be demolished by placing a guncotton charge at the bottom of the bore and tamping with sand or water; 1½ lbs. is sufficient for light, 4 lbs. for heavy guns up to 6-inch.

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SAPPING.

Sapping is that part of the work where trenches are dug underground, usually in the direction of the enemy from forward trenches for mining purposes, or to push forward observation posts or machine gun positions, or for smoother light object when it is impossible to get closer to the enemy in any other manner. Naturally the construction of saps is very slow, as they are narrow, and the rate of progress made depends entirely on how fast the man who is excavating does the work. While those behind him pass back and dispose of the earth. This method is called sapping. Care must be taken in all sapping operations to keep men and material used in its construction away from the view of any enemy observers, as they would at once suspect the existence of a sap and knowing its general location would take such measures as were necessary to destroy this work. Sapping may be carried on digging in the open, under cover of darkness and roofing this over as they advance, care being taken that all portions are roofed over and merged in with the natural features of the ground before daylight appears. The forward man in the sapping party in cutting forward should keep the width, irrespective of depth, as narrow as possible, with walls as straight as possible, so sides of the trench will not fall in. This man is responsible for proper direction and depth. In ordinary or firm soil a smallest cut in which a man can work at 6½ feet below ground would be about 2 feet at the top in width and 1 foot 6 inches at the bottom. The men following him will widen this sap to normal width, which is 3½ feet at the bottom, and, should it be necessary, these approaches may be widened as time goes on. The top width will naturally depend on the steepness that the consistency of the soil will stand, and will not be less than 4 feet, providing there is a gradual widening of the bottom. Occasionally it will be found necessary to support

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roof and sides with timbers. This will ordinarily mean that the sap will be made wider. The rate of progress through average soil 6½ feet deep, without interruption, may be from 1½ to 2½ feet forward for every hour of actual work. As a daily average for a day of 24 hours, when close to the enemy, good progress would be estimated at 30 feet.

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TANKS.

These large land monitors, commonly referred to as "tanks," came as a complete surprise to the enemy when first used, causing great destruction and panic among them. Their first use was naturally in the way of an experiment to test their effectiveness, and once this had been proved the production and manufacture of them was given stimulus, and they are now being turned out in large numbers by both the English and French Governments.

Their origin is a matter of discussion, but the consensus of opinion seems to be that they originated from an American traction engine which came into common use some years ago.

The actual construction of these tanks naturally is not open to inspection by the public, and as newer types are being continually made as improvements are discovered and as a full knowledge of these land forts is not necessary, a very general description only is given.

The tank may be said to consist of a body approximately 20 feet long by 12 feet wide and 8 feet high, covered with heavy armor plate, with two movable turrets, one on each side. Movable portholes are provided for machine guns and guns of larger calibre. The motive power is furnished by two petrol engines, which act on two continuous armored traction wheels, which in turn run over a series of smaller guide wheels, thus creating propulsion.

The width of these large wheels, which rotate slowly about and beyond the body, is about 12 inches. These are in flat sections, with gripping strips to make traction easier over various kinds of ground.

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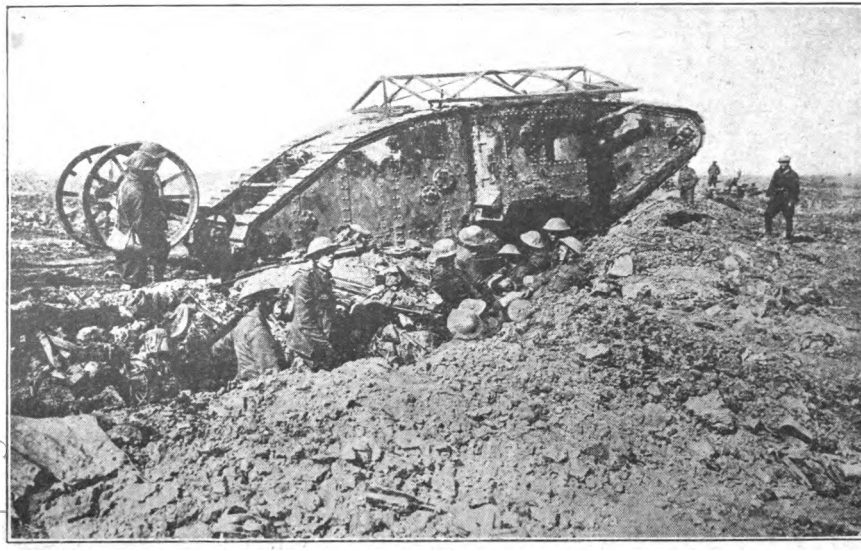

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SIDE VIEW BRITISH TANK, SHORTLY AFTER AN ACTION

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In rear of the main body and projecting behind are two wheels with hand connections to the main body. These wheels serve to start the tank and help in all its maneuvers.

An officer and crew of approximately eight men man these tanks, and consist of mechanician and driver with the gun crews.

Action of the Tanks.—Tanks must be regarded as accessory to other means of attack; in other words, to the advance of infantry with artillery co-operation.

In making out operation orders for an attack in which "tanks" are to take part, such means must be taken as will not jeopardize the success of the attack should the "tanks" fail in their action.

Should an attack be made without artillery co-operation (which seldom happens), the ideal manner of doing so is to send the "tanks" ahead of the lines of infantry, so as to reach enemy lines first.

When going forward to the attack with artillery co-operation, they must not be more than 50 yards ahead of the infantry, as otherwise they will come under our own artillery barrage, and the "barrage" should not be altered for the "tanks." This is the ideal way, but unfortunately, owing to the fact that the noise of the approach of the "tanks" will bring down the enemy's artillery fire and thus stop an attack, it has not been found practical to bring them closer than about 400 yards of the enemy front line.

It is seen, then, that to the distance between opposing trenches must be added the balance of the distance to allow 400 yards to the point where it is considered safe for the "tanks" to start an attack.

Owing to the slow time made by tanks (about 15 yards per minute), it will be seen that when the attack is made they are too slow to catch up to the infantry lines of attack and so necessarily must follow on and deal with any strong points or points of resistance which are holding up the advance of the infantry.

Before an attack is made careful reconnaissance of the ground over which the attack will go must be made by the tank officer.

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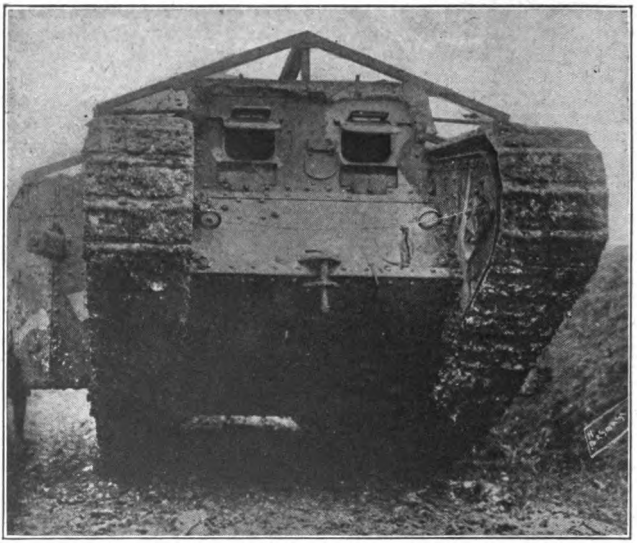

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FRONT VIEW, BRITISH TANK

Maps must be carefully studied and aeroplane photographs carefully gone over and all points which may hold up an advance carefully marked, so that tanks can be provided to deal with them.

The ground and the routes to be followed must be carefully registered to provide for a safer and quicker progress being made. These routes, of course, will not necessarily be followed, as the "tanks" may be required "at any point" once the attack is launched.

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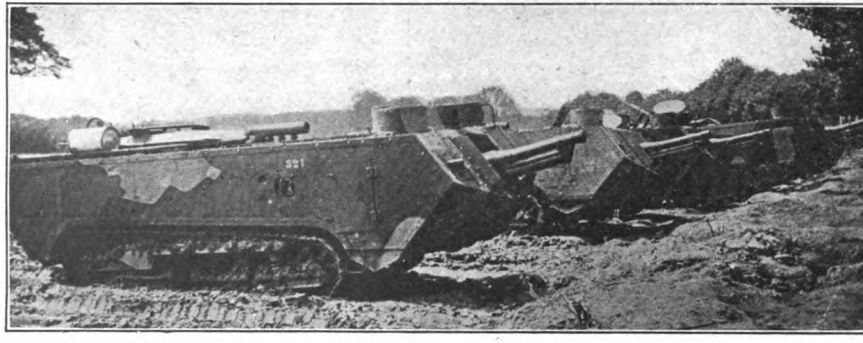

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SIDE VIEW, FRENCH TANK AT REST IN BILLETS, REAR OF LINE

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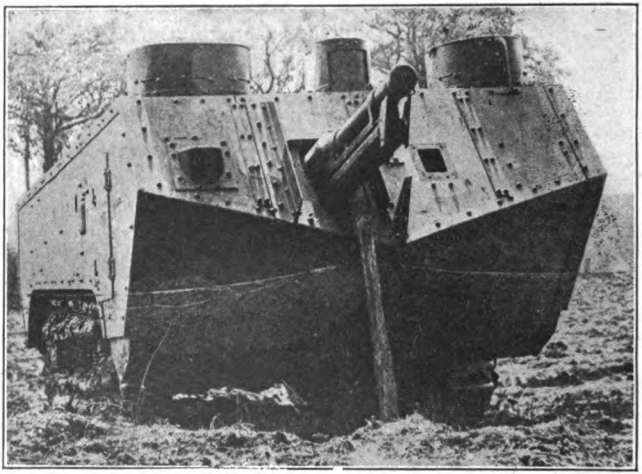

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FRONT VIEW, FRENCH TANK

The tank officer should work in conjunction with the commanding officer of the battalion occupying his frontage, as this battalion will naturally have a better idea of the obstacles to be dealt with and the points at which trouble may be anticipated.

The speed of the "tanks" will be lessened where the ground is badly cut up by shell fire, craters, etc., and in soft and wet ground, so that where possible these spots should be avoided.

Special orders to each "tank" officer must be given as to the particular part he is to play in the general scheme. These orders should be clear and as brief as possible, and in addition each "tank" officer should make himself acquainted in a general way with the whole scheme of operations involved in the attack.

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In moving "tanks" up to their position before an attack, reconnaisance must be made beforehand and the route picked out and where necessary marked out with white tape, as all "tanks" must move into position at night.

Guides should be furnished to "tank" officers over ground to which they are unaccustomed.

Machine gun and rifle fire will help to drown the noise of "tank" movements behind the line and should be resorted to when necessary.

When infantry are following "tanks" over barbed wire entanglements, they will find that the passage made is quite passable, but loosely coiled wire will lie about. This must be carefully avoided.

A special "tank" officer should be appointed whose special duty it is to see that everything in connection with the action of the "tanks" is carefully carried out.

Proper syncronization of watches must be checked with all "tanks," and the hour and moment at which each "tank" will start forward to the attack must be given.

It must be remembered that while "tanks" can force their way through heavy brushwood, over wire entanglements and trenches, they cannot go through woods with trees of any size.

As a rule they follow the roads in villages as in crossing ruins they are liable to fall into basements or cellars, as their weight is great.

Infantry will establish communication with "tanks" by the use of signals with their rifles, while flags may be used by the "tanks" to answer. At night colored signal lights may be used to call on the "tanks" for assistance.

The construction of the French "tanks" is somewhat different from the above description, but their action is much the same.

Grenades and bombs usually will not have any effect on the heavy "tank" armor plate, but a direct hit with a shell from field artillery may have disastrous results.

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GAS.

GAS HELMETS AND THEIR USE.

Gas was first used as a means of attack in the spring of 1915 against the French and Canadian troops, who were then holding positions on the Ypres salient and came as a complete surprise to the Allies, as it was not thought possible that the enemy would stoop to such atrocious measures.

Coming as it did as a complete surprise, catching the opposing troops unprepared in any way to meet this new phase of warfare, it is not surprising that the losses were so heavy. On it came a thick wall of destruction. Some of the troops stood as long as possible, shooting through this wall of gaseous smoke in the general direction of the enemy, but a few breaths of the gas and they fell suffocating to the ground. Other troops retreated, and by the occupation of points above ground not so affected by the gas clouds finally held the German infantry to a point where they were forced to dig themselves in.

Measures were immediately taken by the military authorities as a defensive means against the further use of cloud gas, and as immediate measures were the greatest consideration the French and Belgian women folk were furnished with material and directions for its use and gave birth to the first defensive measure against gas fumes.

This consisted of a pad of absorbent cotton about 6 inches long and 4 inches wide, with tapes attached to tie around the head. This was then dipped in a chemical solution and tied over the mouth when a gas attack was suspected.

The chemical solution was carried in a bottle by each section for use when required.

This temporary means of defense gave way in time to one similarly made but of larger dimensions, which reached to the eyes.

These pads were used or kept ready for use till the issue of the first really effective gas defensive mask was issued by the military authorities.

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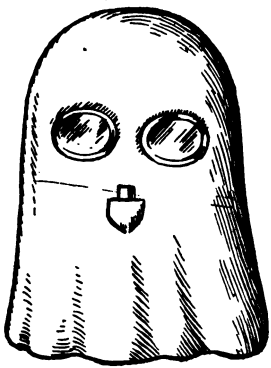
This mask, generally referred to as the P. H. helmet or tube helmet, consists of a flannelette bag which pulls over the entire head. This bag is chemically treated. Inserted in the front are glass windows for the eyes. The helmet is fitted with a mouthpiece with a valve which is rubber covered, and when in use is gripped by the teeth. (See Sketch "J.").



P.H. GAS OR TUBE HELMET

SKETCH "J"

This helmet being chemically treated, the material acts as a filter and all air breathed in the lungs must pass through the flannelette. During its passage through the material of the helmet, the poisonous gas is absorbed by the chemicals.

The air is breathed in through the nose of the wearer and exhaled through the valve in the mouthpiece.

It must be borne in mind that the chemicals will be gradually destroyed by undue exposure to the air and by the breath, therefore a valve is provided to breathe out

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through. All helmets should be exposed as little as possible to the air, and regular helmets should not be used for practice purposes.

The helmet is provided with a satchel (also chemically treated), which contains the helmet and is slung over the shoulder and outside the equipment (and greatcoats when worn), so that they can be readily got at and detached for wearing at a moment's notice. They must be kept from exposure and dampness and only removed for inspection.

The action of putting on this mask is as follows in the trench when the helmet is fastened to the chest with safety pins in its container:

Quickly remove the helmet from the container and pull over the head. Immediately with one hand tighten the loose material around the neck, while with the other free hand adjust the mouthpiece and grip the valve with the teeth (the breath to be held meanwhile). Then unfasten top button of tunic or coat and twisting the helmet tightly about the neck bring the loose ends of the mask under the coat collar and then button same.

Great care should be taken to tuck well under the collar, as many cases of "gassing" have been caused by helmets not being tucked in properly under the coat.

When in action an officer wishing to shout an "order," he can do so by removing the valve from the mouth for the moment.

When putting away the helmet the greatest of care should be taken, as masks not properly folded may spring leaks through cracking of the flannelette material.

The following instructions should be adhered to:

After the completion of Figure No. 3, the helmet is then placed in the satchel provided.

To give the men the necessary feeling of confidence in their helmets, they are passed through a gas chamber before going into the trenches for the first time.

Helmet drill should be carried out frequently to teach the men quick adjustment of the helmets under all conditions, to accustom them to wear them for long periods, and should be practiced both in daytime and at night.

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Instruction for folding the Tube Helmet.

(*A*) Lay helmet down, with window underneath, and fold over the sides as shown in Fig. 1.

(*B*) Turn over helmet and arrange valve as shown in Fig. 2.

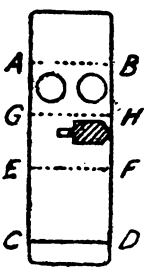
(*C*) Fold down top along line A—B, Fig. 2, as shown in Fig. 3.

(*D*) Fold back the bottom along C—D, Fig. 2.

(*E*) Fold up bottom again along E—F, Fig. 2, so as to cover valve as shown in Fig. 3, taking care that valve is quite flat.

(*F*) Fold along G—H in Fig. 3.

1.



2.

3.

(*G*) To avoid fraying of material round the valve-seating or eyepieces, see that the material is *folded loosely without unnecessary strain.*

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Men must not use their own helmets for drill purposes. Helmets marked "drill" will be kept by all units for training while in rest billets.

The following points are to be noted:

1. Men must be timed against a watch in removing the helmet from its container, getting it over the head and gripped at the neck with one hand so that the material is tight all around. This should take less than 10 seconds and the importance of continual carrying out of this practice cannot be too strongly emphasized. Men should be taught to hold the breath while putting on the helmet, as a few breaths drawn in concentrated gas may be followed by serious results. The remainder of the adjustment is to be completed with the free hand before the hand below the chin is removed. Officers should turn up the collars of their coats after the skirt of the helmet has been tucked in, fixing them in front by means of a safety pin carried for the purpose, or by a special button. Many cases of "gassing" have been caused by helmets not being tucked in properly under the tunic.

2. It must be seen that every man is breathing out through the valve.

3. Men must be warned that during a gas attack, the smell of the chemical on the helmet becomes stronger and causes slight irritation to the eyes, nose and throat, and that this smell does not indicate that the gas is coming through the helmet.

4. Practice in simple movements in helmets, physical drill, including arm and leg exercises, leap-frog and doubling. The time of practice should not exceed fifteen minutes at first, and should be gradually extended. Men must be accustomed to wearing their helmets for at least one hour.

5. Men should advance with the helmet rolled on the top of the head. At a given signal, the helmets should be pulled down and tucked in and the advance continued on rough ground.

6. Men must be taught that misty eyepieces can be cleared by rubbing against the forehead.

7. Practice in bombing, rapid loading and aiming,

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judging distance and range practice should be carried out while men are wearing the helmets.

8. Telephone operators must be specially practiced in using their instruments when wearing tube helmets, the headpiece of the receiver will be worn over the helmet. The buzzer should be used when the helmet is worn unless a message is urgent.

9. Men will be practiced in changing from one helmet to another without drawing breath in the process.

10. When used for instruction, the rubber covering of the mouthpiece should be removed. Medical officers in care of units will arrange for the sterilization of the mouthpiece after use by means of chemical disinfectant of a suitable strength.

11. Men must swallow their saliva from time to time when wearing the helmet and not allow it to drain out over the lips or through the valve.

12. Officers and N.C.O.'s will receive the same training as the men and in addition will be practiced in giving orders whilst wearing their helmets.

Alternative Method of Wearing Anti-Gas Helmets When Wind Is Favorable for a Gas Attack.

1. Put the helmet on in the usual way. Pin the front edge of the helmet and the top edge of the opened waterproof satchel to the shirt with two safety pins in such a manner that the helmet may be readily pulled on and off the head without removing the pins, the satchel hanging loose below it.

2. Leaving the safety pins in position, remove the helmet and fold it to the usual width, keeping the valve horizontal and flat. Now roll up the helmet and tuck it inside the jacket. Cover with the waterproof satchel by pulling up the latter so that it lies in front of the helmet, and button up the jacket with the exception of the top two buttons.

3. On the gas alarm sounding, pull out the helmet, pull

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it over the head, and adjust in the usual manner. The waterproof bag hangs suspended by the pins and is ready for use if required.

The adoption of this method avoids the irritation of the forehead that sometimes follows wearing the helmet rolled up on the head.

The following box respirator has advantages over the tube helmet and superseding it gradually:

Description.—The respirator consists of a box, packed with chemicals, connected by means of a flexible rubber tube with a face-piece. The inspired air enters through valves in the bottom of the box; the expired air is expelled through a valve just outside the face-piece. The wearer breathes in and out through the mouthpiece; breathing through the nose is prevented by a noseclip inserted in the face-piece.

The face-piece is soaked in chemicals and is sufficiently large to enable the wearer to take the mouthpiece from his mouth in order to speak.

General Instructions.—(a) Every one who has a box respirator will carry one tube helmet in addition. In the case of a gas attack, the box respirator will be used first.

(b) Box respirators will be taken into the trenches and brought away from them on relief.

(c) Box respirators will be carried or kept close at hand at all times.

(d) Every one having a box respirator will practice wearing it, especial attention being paid to the rapidity of adjustment. The time for which each box respirator is used for drill purposes must not usually exceed a total of one hour.

Directions for Using the Box Respirators.—(a) When in use, the haversack containing the box is to be carried on the chest, with the hook at the back tucked into the belt, and with the strap around the neck.

(b) When the box respirator is to be used, take the face-piece out of the front pocket of the haversack, but leave the tin box in its place in the other pocket.

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(c) Put the end of the mouth-tube in the mouth, with the rubber valve pointing downwards and the elastic bands on top. Close the lips around it and begin at once to breathe in and out through this tube; you are then protected from the poisonous gas.

(d) While holding the tube in the mouth, place the lower edge of face-piece under the chin and pull the elastic bands up over the head so that one is nearly on the top of the head and the other one is just above the back of the neck.

(e) Open the noseclip at the top of the face-piece by pulling on the two tabs and fit it on the lower part of the nose so that the nostrils are closed by it, and push the top of the face-piece up under the goggles if these are being worn.

If either elastic band is loose, it can be tightened by means of the hooks at the back.

(f) Put on your goggles if they are not already being worn.

(g) While wearing the respirator the saliva must be swallowed from time to time to prevent moisture from accumulating in the valve or face-piece.

(h) If it is absolutely necessary to speak while wearing the respirator, take hold of the metal mouth-tube and draw it forward clear of the mouth without disturbing the face-piece. When it is desired to speak, a long breath will be taken through the tube before removing it from the mouth. Speak only while breathing out. Put the tube back in the mouth before the next breath is drawn in. The box respirator gives complete protection as long as the breathing tube is used, but tear-gases can sometimes penetrate during speaking, if the breath is drawn in without the tube. Do not speak for longer than is absolutely necessary, and put the tube back into mouth as soon as you have finished speaking.

Care and Inspection.—Box respirators must be kept dry, and must not be subjected to rough usage.

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They must be inspected once a week, attention being paid to the following points:

(a) Face-piece, noseclip and elastic in good order.

(b) Face-piece firmly attached to mouthpiece.

(c) Rubber tube intact and firmly attached to box and mouthpiece.

(d) The expiratory valve should be tested by clipping the rubber tube, and seeing that the valve allows air to pass freely out and not in.

(e) See that the box is not damaged.

(f) See that the goggles are in order.

Note.—The eyepieces of the goggles should be rubbed with "Glasso" at each inspection to prevent dimming with moisture. Apply a little of the paste to the inside of the glass eyepiece, rubbing it hard into the glass. Then polish off as much as possible with a dry rag, leaving the glass quite clear.

Dimming of Anti-Glass Goggles.—A preparation called "Glasso" is used, and when applied to the inner surface of the windows and eye-pieces prevent this dimming from condensation of moisture.

The preparation or paste is applied with a rag, then wiped off after rubbing and should be applied weekly.

Gas Attacks.—The Germans when making a gas attack have invariably used "chlorine" gas and launch a gas attack in the following manner:

The gas is brought up to the trenches compressed in steel cylinders. These are dug into the bottom of the trench and connected with pipes leading over the parapet.

When the valves of the cylinders are opened, the gas escapes with a loud, hissing noise, mixes with the air and is carried by the wind to the opposing trenches, spreading out in a continuous cloud as it goes.

The appearance of the gas as a cloud may vary according to the weather. On a dry day it may appear greenish in color, while on a damp day it is usually white.

Smoke of any color to make the cloud denser for tactical reasons may occasionally be used.

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Gas attacks may be made in wind velocities of from three to fifteen miles per hour.

Troops should be impressed that with a nine-mile wind gas would travel over 100 yards of ground in 20 seconds. This will teach them that the practice of putting on gas helmets quickly is absolutely necessary.

Defensive and Precautionary Measures.—The warning of a gas attack may be from the following:

a. By the noise of gas escaping from the cylinders.

b. By the appearance of a cloud of gas over the enemy's line.

c. By the smell of gas in forward listening posts.

To provide against being surprised in a gas attack the following measures should be taken:

a. Listening posts should occupy saps, or ground well to the front.

b. At night all sentries should have men handy to spread and sound the alarm.

c. Men should be warned to have their helmets ready for immediate use.

d. Sentries should be posted over groups of dugouts to warn sleeping men.

e. Wind observations should be made at regular intervals by officers along the front line.

f. If gas attack is expected, helmets should be rolled on the head ready for immediate use.

g. A good system of alarm by Ploxon horn, pebble cans, iron rails and other devices right through from front to rear.

In regard to precautions it must be impressed on all that gas may be felt as far as one to five miles behind the line, depending on the quantity and the wind.

Gas Alarms.—Proper appliances and contrivances for giving the alarm in case of gas attacks must be carefully provided for in advance and should be of two kinds.

The first in the form of gongs, rails, etc., at each sentry post, which are beaten directly gas is detected and

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will arouse the men in their immediate vicinity, the signal being passed along by all sentries as soon as heard.

The second of hooters worked by compressed air, strombo horns in conjunction with telephone communication are to signal troops in support and reserve lines of an impending attack and thus give them time to prepare.

Action to Be Taken When Alarm Is Sounded.—1. All ranks immediately don helmets or box respirators.

2. Wake all men in trenches and dugouts; warn officers and artillery observation posts.

3. Company commanders call for artillery support and warn battalion headquarters.

4. Infantry man trenches and with machine guns and trench mortars open fire on enemy trench from which gas is coming.

5. Carefully close dugout entrances with blanket covering doors.

Gas Shell Attacks.—The Germans make frequent use of 'gas lachrymatory," or "tear" shells and trench mortar bombs, generally as a barrage to shut off the supports.

The liquid in these shells is converted into a dense white cloud of vapor by the explosion. This causes intense irritation and watering of the eyes, and is often sufficiently concentrated to irritate the throat and cause coughing and ultimately vomiting.

Sufficient liquid may remain about the shell holes to cause discomfort for a number of days. Men should be told that no effects other than transitory sickness or discomfort have hitherto been caused by "tear" shells.

It should be remembered that a bombardment with gas shells, not necessarily "lachrymatory," may take place whatever the direction of the wind.

Goggles are being used for the protection of the eyes. If the gas gets so concentrated that the nose or lungs also are affected, the tube helmet should be put on over the goggles.

GAS DRILL.

Men must not use their own helmets for drill purposes. Helmets marked "drill" will be kept by all units for training while in rest billets.

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The following points are to be noted:

1. Men must be timed against a watch in removing the helmet from its container, getting it over the head and gripped at the neck with one hand so that the material is tight all around. This should take less than 10 seconds and the importance of continual carrying out of this practice cannot be too strongly emphasized. Men should be taught to hold the breath while putting on the helmet, as a few breaths drawn in concentrated gas may be followed by serious results. The remainder of the adjustment is to be completed with the free hand before the hand below the chin is removed. Officers should turn up the collars of their coats after the skirt of the helmet has been tucked in, fixing them in front by means of a safety pin carried for the purpose, or by a special button. Many cases of "gassing" have been caused by helmets not being tucked in properly under the tunic.

2. It must be seen that every man is breathing out through the valve.

3. Men must be warned that during a gas attack, the smell of the chemical on the helmet becomes stronger and causes slight irritation of the eyes, nose and throat, and that this smell does not indicate that the gas is coming through the helmet.

4. Practice in simple movements in helmets, physical drill, including arm and leg exercises, leap-frog and doubling. The time of practice should not exceed 15 minutes at first and should be gradually extended. Men must be accustomed to wearing their helmets for at least one hour.

5. Men should advance with the helmet rolled on the top of the head. At a given signal the helmets should be pulled down and tucked in and the advance continued on rough ground.

6. Men must be taught that misty eyepieces can be cleared by rubbing against the forehead.

7. Practice in bombing, rapid loading and aiming, judging distance and range practice should be carried out while men are wearing the helmets.

8. Telephone operators must be specially practiced in using their instruments when wearing tube helmets, the headpiece of the receiver will be worn over the helmet. The buzzer should be used when the helmet is worn unless a message is urgent.

9. Men will be practiced in changing from one helmet to another without drawing breath in the process.

10. When used for instruction, the rubber covering of the mouthpiece should be removed. Medical officers in care of units will arrange for the sterilization of the mouthpiece after use by means of chemical disinfectant of a suitable strength.

11. Men must swallow their saliva from time to time when wearing the helmet and not allow it to drain out over the lips or through the valve.

12. Officers and N. C. O.'s will receive the same training as the men and in addition will be practiced in giving orders whilst wearing their helmets.

Vermorel Sprayers and Syringes.—During an attack the gas sinks into the trenches and dugouts and remains there after the cloud has passed. Vermorel sprayers and syringes are provided for clearing out the gas when the attack has ended. They should be distributed at easily accessible points in or near the trenches and protected from shell fire. Sprayers must be kept one-third full of water. Six gallons of the following solution for use in the sprayers must be kept in corked rum jars or other closed receptacles close to each sprayer; it must not be kept in the sprayers, owing to its corrosive nature:

Water, 3 gallons (one large bucket).

Sodium thiosulphate (hypo) 1½ pounds (¾ mess tin).

Sodium carbonate (washing soda) 3 pounds (1½ mess tins).

Three rum jars are required to hold the above quantity and the necessity for keeping them corked must be impressed on the personnel responsible for it.

Each company should have a squad of men in charge of the company gas N. C. O. trained in the care and use of sprayers. On taking over trenches, this N. C. O. will take over the outgoing gas N. C. O. and will see that each sprayer is in good order and provided with solution. A

man will be told off to each sprayer; he will be responsible for testing it every day, and in case of gas attack he will stand by to use it.

Protection of Dug-outs.—This is desirable in the case of battalion or brigade headquarters, artillery and signal offices, and any place where work has to be carried on during a gas attack, but not in the case of shelters for troops, which should be vacated at such times.

In order to protect dug-outs against gas, the entrances must be closed with well-fitting doors, or by blankets moistened with water or vermorel sprayer solution. Trials have shown that little gas passes through a wet blanket, and the protection depends on getting a good joint at the sides and bottom of a doorway so as to stop all draughts. This can be effected by letting the blanket rest on battens fixed, with a slight slope, against the door frame. The blankets should overlap the outer sides and a fold should lie on the ground at the bottom. Types can be seen at divisional and army anti-gas schools. If two blankets can be used with an air-space of not less than 3 feet between them, complete protection can be obtained and the entrance can be used without admitting large quantities of gas.

When not in use, the blankets should be rolled up and held so that they can be readily released, and should be sprayed occasionally with a little vermorel sprayer solution.

Blankets must be dropped immediately the gas alarm is given and as little movement as possible should take place in and out of a dug-out during a gas attack. Men going in or out should close one blanket carefully before raising the other and pass through very quickly.

If the blankets become stiff from a deposit of chemicals they should be sprayed with water.

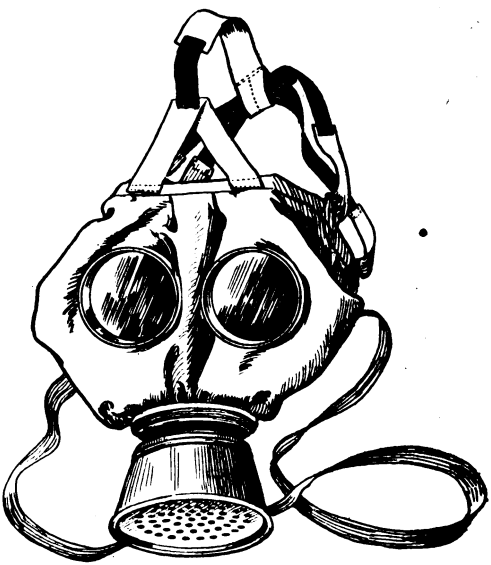
GERMAN TYPE OF GAS MASK.

The following description is that of a German gas ma. of the type most commonly in use by all their troops:

A comparison between this helmet and the one in use by the Allies will show that the ones adopted by us are

much superior, as in the use of the above mask the chances of a leak are much greater, and the quick adjustment of same is not so easily made with safety.

This mask or helmet is made of a chemically treated, rubber-covered material, shaped to fit tightly around the forehead, covers the whole front of the face and fits tightly under the chin. It has glass-covered eye-pieces, but no mouth-piece. Through the lower portion is suspended a metal receptacle (which can be unscrewed), which is packed with a chemical solution and sponge.



SKETCH "L"

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The bottom of this receptacle is perforated, and the gaseous air passing through these perforations is absorbed by the chemicals before reaching the mask proper.

The mask is held on the face by an arrangement of straps which pass over the top of the head. A looped tape is attached to suspend the mask from the shoulders when not in use.

The whole mask, with an additional "chemical container," is carried in an air-tight metal case, which is carried slung over the shoulders. (See Sketch "L.").

ANTI-GAS DUTIES WITHIN AN INFANTRY BATTALION.

(To be modified for other units to suit their organization and duties.)

1. The commanding officer will be directly responsible for all measures of defense against gas attacks.

2. Company commanders will be responsible to the C. O. for all anti-gas measures within their companies.

3. In each company, one N. C. O., who has been trained at an anti-gas school and who has been recommended by the divisional gas officer as suitable for duty as "company gas N. C. O.," will be specially detailed to assist the company commander in anti-gas measures. At least one other similarly trained and recommended N. C. O. will be immediately available to take the place of the gas N. C. O. in case of need.

4. A similarly trained gas N. C. O. will be detailed to battalion H. Q. for duty with H. Q. details.

5. The duties of gas N. C. O's. will be definitely laid down in battalions. Other duties may, however, be performed, provided that these do not interfere with the gas duties laid down.

6. In order to secure the necessary training in all matters pertaining to defense against gas attacks, the following officers and N. C. O's. will attend a course at the divisional anti-gas school as soon as circumstances permit:

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(a) **Officers.**

(i) The commanding officer or second in command.
(ii) All company commanders.
(iii) Other officers and warrant officers if and when possible.

(b) **N. C. O's.**

(i) Two per company and per battalion H. Q.
(ii) Supplementary N. C. O's. to be trained whenever possible so as to have a reserve from which to draw to replace gas N. C. O's. in case of need.

7. The selected N. C. O's. who attend the divisional anti-gas schools will be reported on by the divisional gas officer as follows: At the end of the course the divisional gas officer will, if the N. C. O. is, in his opinion, suitable for duty as "company gas N. C. O.," notify the C. O. concerned to this effect. The latter will then cause the words, "passed anti-gas school," to be entered in his pay book. Only N. C. O's. who have been thus reported on favorably will be detailed for duty as company gas N. C. O's.

8. The divisional gas officer will keep in constant touch with units in order to advise commanding officers on all technical questions relating to anti-gas defensive measures and for the purpose of inspecting anti-gas appliances of all kinds.

9. A N. C. O. from the divisional gas school will visit the trenches once a week to inspect anti-gas appliances and test the pressure of the Strombos horn cylinders. He will report the results to the company commander.

10. After a gas attack, all information and samples which have been collected will be forward at once to the divisional gas officer.

DUTIES OF COMPANY GAS N. C. O'S.

1. They will assist officers at the inspection of gas helmets, box respirators and goggles, and in making such local repairs as are possible. They will assist in training men in the use of anti-gas appliances.

2. Under the company commander, they will have charge of all anti-gas trench stores as follows:

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(a) **Strombos Horns and Other Gas Alarm Devices.**—Inspect daily and see that sentries posted to them know how they should be used.

(b) **Gas-proof Shelters.**—See that the blanket doorways fit and are kept in good order.

(c) **Anti-Gas Fans.**—See that they are in their proper position and in serviceable condition.

(d) **Vermorel Sprayers.**—Maintain in working order.

(e) **Gas Sampling Apparatus.**—Have charge of the vacuum bulbs and gas-testing tubes. Keep a stock of corked bottles and small tins with well-fitting lids for collecting samples of earth and water after a gas shell attack.

3. On relief they will assist the company commander in taking over all anti-gas trench stores. The company gas N. C. O. should accompany the advance party and take over anti-gas trench stores (by daylight if possible).

4. They will make wind observations every three hours, or more frequently if the wind is nearing a dangerous quarter, and will report any change of wind to the company commander.

5. During a gas cloud attack they will take gas samples by means of the vacuum bulbs.

6. During or after the attack, the N. C. O. should note down in writing as much information regarding the attack as possible.

7. As soon as possible after the conclusion of a gas shell bombardment, the gas N. C. O. must fill his bottles and tins [2 (e)] and take samples of water, mud or earth from those parts of the line which are smelling most strongly of shell gases.

8. As soon as possible after a gas attack, all samp and notes will be handed in to the company commande for transmission to the divisional gas officer.

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LIQUID FIRE ATTACKS.

The German **flame projector,** used against us hitherto, consists of a cylinder containing oil and compressed nitrogen, which can be carried on a man's back. The compressed gas is used to force out the oil, which ignites at the jet and spreads out in a broad cone of flame and smoke. This covers about 6 yards of front when stationary, and has an extreme range of only 30 yards and a duration of **one minute.** Instruments of a longer range will probably be used in the future.

The smoke is very dense and black, the flames are a yellowish red, and there is a loud roaring noise. The moral effect is liable to be great unless men are instructed in the limitations of the instrument.

The heat developed by the flames is great, but all the burning takes place in the air, and the jet cannot be directed downward owing to the upward current of air caused by the heat. A man crouching down on the firing step or just inside a dug-out, should be quite safe from the flames, while any non-inflammable overhead cover gives perfect protection.

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